

Popular Mechanics

**AEROSOLS aren't
for kids** Page 82

FEB. 1973
50 CENTS

**Mini calculators—
how to choose the right one** Page 86

18 pages of new boats and gear Page 106

**We show you how to make
'expensive' frames for very little money** Page 73

Andrew Wyeth print: \$8
Frame: \$17



A full-page background image showing two cowboys on horseback, seen from behind, riding across a vast, snow-covered landscape under a cloudy sky. The terrain is hilly and desolate, with some distant trees and structures visible.

Come to Marlboro Country.



Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

18 mg. "tar," 1.3 mg. nicotine av. per cigarette, FTC Report Aug. '72

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Two more reasons MerCruiser runs rings around all other stern drives

MerCruiser 120 and 140. The fours that outrun competitive sixes.



When you think stern drive power, here's the place to start. The MerCruiser 120 and 140 stern drives are light and compact, but they'll give you all the full, free power on the water you would want.

Performance comparisons show why. On identical hulls the 140-horsepower MerCruiser outruns competitive 6-cylinder engines rated up to 170 HP . . . and uses less gas while it's at it.

Jet-Prop exhaust makes power quieter

and more efficient. Power Trim puts you in command—dig in to snap skiers out of the water, then plane up and go. Check these standard features against any competitor. And these

MerCruiser safety features: an ignition switch that allows starting only in neutral, a flame-proof distributor.

If you want out-front performance—with a light and easy trailing boat—power up with a MerCruiser 120 or 140. Or, team up a pair to move out a medium-size cruiser. When you talk boats with your dealer, start with the stern. Start with the MerCruiser 120 or 140.



YFGQ-P57-PKSZ

MERCUISER
STERN DRIVES

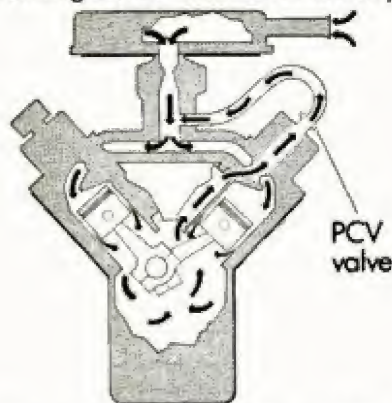
COMMAND POWER LINEUP FOR '73: 120, 140, 165, 188, 225, 255 HP. For nearest MerCruiser dealer, see the Yellow Pages under "Outboard Motors." Mercury Marine/Division of Brunswick Corporation, Fond du Lac, Wisconsin/Canada/Australia/Belgium

Clean air: good reason to use a great oil.

Today's anti-pollution systems are making the temperature of your motor oil higher than ever before. And if your system isn't working properly, that makes it even tougher on your oil and your engine. Today you should name your oil. By type. By SAE Grade. By brand.

Briefly, here's what's happening.

When the PCV valve is working properly, your car's engine is running cleaner than ever. Blowby



gasses that once seeped into the crankcase are recycled back to the combustion chamber. This not only keeps the air cleaner; it also keeps your oil cleaner.

Keep your PCV Valve clean. On the other hand, if the PCV valve gets clogged, combustion or blowby gasses are trapped in your crankcase and form damaging corrosive acids. What's more, today's engines must operate on a leaner fuel/air mixture than did engines in cars without anti-pollution devices. So today, your engine, and its motor oil, are operating under much higher temperatures.

Other systems, more heat. Today's improved combustion systems, supplemental air injection systems, lower compression ratios, air conditioning and power equipment are all "hot items." They put extra stresses on your engine that can send your motor oil's temperature over the 300° level.

What heat can do to motor oil. Heat is motor oil's number one enemy. Because, when heated, oil has a tendency to oxidize. Excessive oxidation causes oil to thicken—and not lubricate properly.



The newest service designation—see the chart—is "SE." It meets 1973 requirements and it's vitally important that you use it when recommended.

Then, especially these days, ask for the highest quality brand you can find. By name.

Old designation	New designation	Oil description
ML (Motor Light)	SA	Oil without additive, except that it may contain pour and/or foam depressant
MM (Motor Medium)	SB	Provides some antioxidant and antiscuff capabilities
1964 MS (Motor Severe)	SC	Oil meeting the 1964-67 requirements of the automobile manufacturers. Provides low-temperature antisludge and antirust performance
1968 MS (Motor Severe)	SD	Oil meeting the 1968-71 requirements of the automobile manufacturers. Provides greater low-temperature antisludge and antirust performance
1971-73 (none)	SE	Oil meeting the 1972-73 requirements of the automobile manufacturers. Provides high-temperature antioxidation, plus greater low-temperature antisludge and antirust performance.

Remedy #1. Change oil frequently. Consider your car manufacturer's oil change recommendations as absolute minimums—under ideal conditions. Take careful note of the warnings against severe operations—such as heavy loads, sustained high-speed driving, constant heavy traffic, dusty roads, and extra cold weather. You might not be changing your oil often enough.

Remedy #2. Know your motor oils. First ask for the service designations and viscosity recommended in your owner's manual.

Why Quaker State offers quality protection: Quaker State is refined from 100% Pure Pennsylvania Grade Crude Oil, the world's choicest. Then it's put through an elaborate refining process.

Finally, it's fortified with a blend of additives, scientifically selected to retard oxidation, clean and disperse harmful deposits and to neutralize acids.

So ask for it, by name: Quaker State.



Quaker State your car to keep it running young.

POPULAR MECHANICS

Jeep® Wagoneer. Bound for the snow, not snowbound.



It's the original snowmobile...and it's got luxury and comfort besides.


With the Jeep Wagoneer, you don't have to head for the crowds. You can head for the fun, wherever it is. That's because it's got the most experienced 4-wheel drive ever made—Jeep 4-wheel drive. It can take you places that would stop ordinary family wagons cold.

The high ground clearance helps you skim through snow that hasn't seen a snowplow. The frame, of hot-rolled steel with five rugged cross-members, resists unseen rocks and ruts along the

way. And the Jeep engine packs the extra power you need to keep on moving.

There's an inside story, too, with plush seats for comfort. And a fully-padded instrument panel for safety, with new easy-to-read gauges for convenience. You can order just about any option, from air conditioning to a snowplow. With the Jeep Wagoneer, you're bound to have a good time.

Toughest 4-letter word on wheels.

 **Jeep**

Buckle up for safety...drive your Jeep vehicle with care and keep America the Beautiful.

FEBRUARY 1973

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ON THE COVER: Some of the 27 picture frames created in the PM Shop by our Workshop Editor for you to duplicate (see page 73). The framed reproduction in the photo is *Christina's World* by Andrew Wyeth, which is copyrighted by the Museum of Modern Art, New York. Cover photo by Robert D. Borst.

WORTH WRITING FOR: SEE PAGE 56C

AS A SERVICE TO READERS, Popular Mechanics publishes newsworthy products, techniques and scientific and technological developments. Because of possible variance in the quality and condition of materials and workmanship, Popular Mechanics cannot assume responsibility for proper application of techniques or proper and safe functioning of manufactured products or reader-built projects that result from plans published in this magazine.

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Is tomorrow the morning you break the double-edge habit?



©Schick Safety Razor Co., Div. Warner-Lambert Co.

Is tomorrow the morning when you stop to think: What good is a double edge if you can only shave with one edge at a time?

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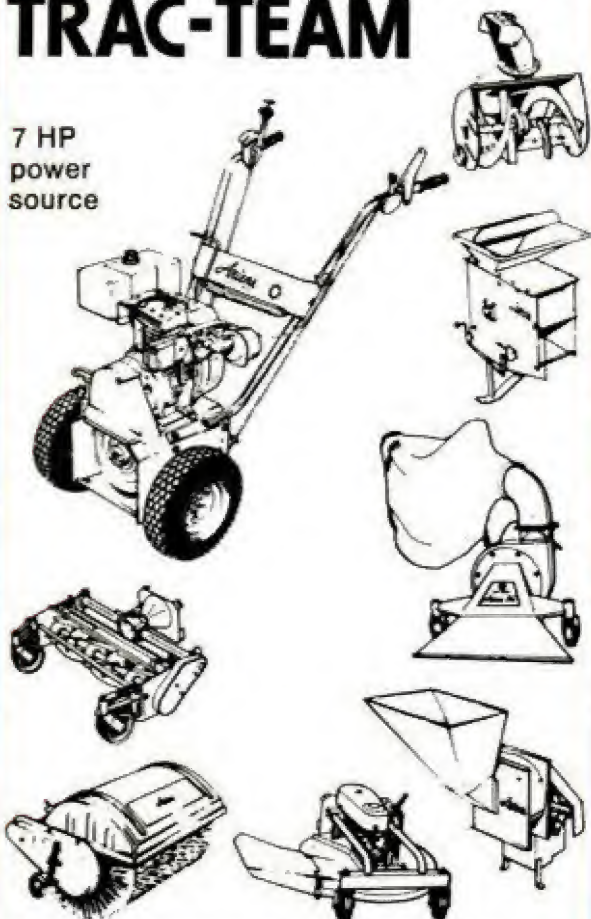


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Manufactured by Warner-Lambert Company, Detroit, Michigan

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POPULAR MECHANICS

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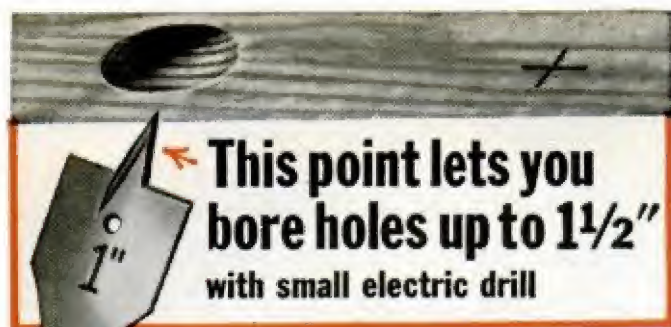
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Each Irwin Speedbor "88" forged from single bar of finest tool steel. Each machine-sharpened and heat tempered full length for long life. 17 sizes, ¼" to 1½", and sets. See your Irwin hardware or building supply dealer soon.

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LETTERS TO THE EDITOR

Something fishy about the fluke

On the cover of your November issue you have pictures of whales sculptured in wood. The sculptor made one major goof. Fish have vertical tails, and whales have horizontal flukes. The whales on the cover have vertical flukes.

HOLLIDAY, MO.

MARK WILSDORF

We call that artistic license, Mark.

Two-way static

Two-way radio—tool or toy? (page 120, Dec. PM) had a few errors in it.

Channel 9—not 19—is the official Citizens Band emergency channel. Before a CBER commences transmission, he should be aware of this and of whatever other channels may be monitored in his community and should commit those channels to memory.

Also, Class D licenses were authorized by Congress in 1958, and service commenced immediately (the article said 1965).

Any person desiring to become a CBER or renew his license may write us, as we have a substantial quantity of the required forms on hand.

MOTIVATION COMMUNICATIONS

88 BALLANTYNE ROAD D. MOSKOWITZ
ROCHESTER, N.Y. 14623

There were several mentions of emergency Channel 9 in the article and only one with the erroneous figure 19. Unfortunately, the wrong one turned out to be the most prominent.

Big wheels

I came from the Isle of Man and have seen the *Big wheel* (page 15, Dec. PM) pump water out of the lead and silver mines in Laxey. My father told me that the wheel was designed by a Manxman, Robert Casement. Its name is *Lady Isabella*.

FRANKLIN, IDAHO

GEORGE E. MYLROIE

We didn't match that water wheel in overall diameter, but we went three better

(Please turn to page 10)

POPULAR MECHANICS



Challenger 12

Pressure molded fiber glass tri-hull
BIA CERTIFIED

\$199.00



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• F.O.B. FACTORY

RICHARD PETTY says:

"If you want to really learn how to repair cars... check out NRI home training"

"NRI provides the most up-to-date complete course in Auto Mechanics I've ever seen."

"My dad made auto mechanics out of us long before he'd let us enter a race. I know the importance of a good mechanic... and the opportunities that are out there for men with the right training. That's why I'm sure glad to see home training like the NRI courses come along. With NRI training behind you, when you open that hood, hands-on experience is going to come fast, and come right. It's a lot of training for a very few bucks."

Earn \$5 to \$7 an hour in your spare time.

As a trained mechanic you can command good money working for yourself or doing spare time jobs. And you'll save a lot on your own car upkeep. NRI gives you a choice of a complete Master Automotive Technician course or a shorter Automotive Tune-up and Electrical Systems training program. Both courses give you the essential training and diagnostic equipment you need for good car repairs. No other school gives you as much training and equipment for your money.



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If you have served since January 31, 1955, or are in service now, check GI line in the coupon.

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FEBRUARY 1973



Richard Petty, America's Winningest Stock Car Racer

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Train with the leader—NRI.

Richard Petty says: "I'm a great believer in being number one. That's why I look to the school that's out in front. And no other school has NRI's experience in home training with professionally developed educational kits. They've graduated hundreds of thousands of students." Mail the coupon and learn

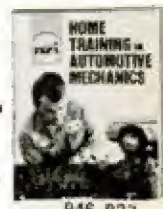
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LETTERS

(Continued from page 8)

in quantity. Four 68-foot-diameter tailing wheels went into operation in 1912 at the Kennedy Mine in the Mother Lode of California. They continued until 1942. Of the original four, two are still standing and are now classified as historical monuments, a tribute to the pioneers of the West.

WEST SACRAMENTO, CALIF. LEE A. HUNT

Pilbara's 1500 years of iron

Now I am confused! In your very interesting account of the *World's mightiest iron mine* (page 90, Nov. PM) is the forecast that "still unexplored regions of the vast Pilbara are expected to yield additional reserves sufficient to keep man in steel for another 1500 years!"

In the best-seller, *The Limits to Growth*, among other alarming conclusions of the present pattern of exponential growth there is a potential conclusion respecting iron, that presently known reserves, used at present consumption, have a possible short life of 93 years.

Further, the same index of consumption projected by an optimistic margin of five times known reserves, will last 173 years.

Author Richard Dunlop should be more respectful of basic facts than evidenced in an otherwise fascinating story. I lean more to the MIT boys in sounding a basic alarm. INDIANAPOLIS, IND. WALTER L. SHIRLEY

"I can't blame Mr. Shirley for being confused," comments author Dunlop. "Until I went to Western Australia, I would have joined him in responding in alarm to the MIT iron-ore projections, but fortunately their researchers were apparently not familiar with the vast iron ore discoveries in the Pilbara.

"Today the world uses 600 million tons of iron ore a year. In 10 years' time it may use 1200 million tons, and it is possible that the consumption of iron ore may double every 10 years after that. Given the world's energy and environmental problems, this is not likely to be the case, but let us assume that these problems may be either exaggerated or solutions to them may be found.

"The reserves of iron ore in the Pilbara are estimated by competent authorities to be an incredible 125,000,000 million tons.

Simple arithmetic would indicate that I was extremely conservative in my statement concerning these reserves. Obviously they can more than satisfy even the most unlikely expansion of the iron and steel industry for far more than 1500 years."

Forget that can opener

A Photo Hint in the November issue (page 15) suggests making a film tank agitator from an electric can opener. Don't do it! Any periodic motion, whether tilting or twisting, will produce standing waves of heavier products in the developer and cause unequal development.

The most reliable agitation for a small tank is to pick it up once a minute and give it a combined twisting and tilting motion for three or four seconds.

DANVERS, MASS.

WILLARD ALLPHIN

That 'bullet-nosed beauty'

They've finally built the airplane of my dreams, I thought when I saw BD-5: *Bullet-nosed beauty* (page 174, Nov. PM). But a closer look at the specs revealed a problem which I feel is misleading.

The aircraft is said to have a range of 1000 miles at 50 mpg, hence a 20-gallon fuel tank. It also professes a useful load of 290 pounds.

With a full tank of gas, the pilot can weigh a maximum of 170 pounds. I know you say that the fuel supply can be reduced to compensate for a heavier pilot or baggage, but what happens to that lovely 1000-mile range?

Don't get the idea, though, that I'm down on the BD-5. I fully intend to build one myself.

SOLEDAD, CALIF.

DANIEL R. PIETZ

Kiekhaefer Aeromarine Motors, Inc., is not "a division of the firm in Fond du Lac, Wis., that developed the Mercury outboard engine." It is not a division of any other company or corporation.

Our president, E. C. Kiekhaefer, was the founder of Kiekhaefer Corp. (now called Mercury Marine) and was president for 31 years, until his resignation in 1970. After resignation, he started a completely new endeavor, Kiekhaefer Aeromarine Motors, Inc. Work was started on a two-cycle, air-cooled engine that would be suitable for snowmobile, ATV, ACV and other small, recreation-type vehicles. The result

(Please turn to page 12)

The secret of teaching yourself music



It may seem odd at first—the idea of teaching yourself music. You might think you need a private teacher at \$4 to \$10 an hour to stand beside you and explain everything you should do—and to tell you when you've made a mistake.

But, the fact is, you don't. Thousands have taught themselves to play with the lessons we give by mail. And you can too. Guitar, piano, accordion—you can learn any of several popular instruments.

The secret lies in the step-by-step way our lessons teach you. Starting right from scratch, they show you with simple words and pictures exactly what to do. You'll learn to play the right way—by note, from sheet music. Without any gimmickry.

But how do you know you're doing it right? Easy. A lot of the tunes you'll practice first

are simple songs you've heard many times. Since you know how they're supposed to sound, you can tell right away when you've "got them right."

By the time you go on to more advanced pieces, you'll be able to tell if your notes and timing are right, even without being familiar with the songs. Sooner than you may think, you'll be able to play whatever kind of music you like. Popular. Classical. Folk music. Hymns.

If you're 17 or over and would like more information, just mail the coupon. We'll send you our free booklet, *Be Your Own Music Teacher* and a free Piano "Note-Finder." No obligation.

U. S. School of Music.

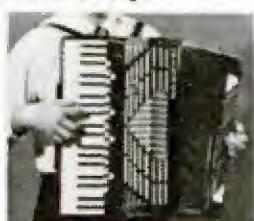
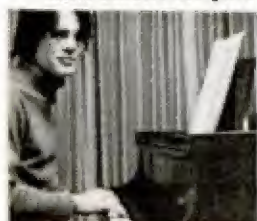
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Port Washington, New York 11050

I'm interested in learning to play the instrument checked below. Please send me, FREE, your illustrated booklet *Be Your Own Music Teacher*. Also include your free Piano "Note-Finder." I am under no obligation. The instrument I would like to play (check only one):

- | | | |
|--|--|------------------------------------|
| <input type="checkbox"/> Piano | <input type="checkbox"/> Spinet Organ
(2 keyboards) | <input type="checkbox"/> Violin |
| <input type="checkbox"/> Guitar (pick style) | <input type="checkbox"/> Saxophone | <input type="checkbox"/> Accordion |

Mr. _____ Age _____
Mrs. _____
Miss _____
PRINT NAME (17 OR OVER)

Address _____

City _____ State _____ Zip _____

Do you have an instrument? Yes ☐ No ☐
Instruments, if needed, supplied to our students on convenient terms.
Accredited Member National Home Study Council

LETTERS

(Continued from page 10)

was the Kiekhaefer 440 engine, perhaps the most thoroughly engineered and tested snowmobile-type engine built in the world. It went into production in 1971.

There was no "delivery snag" in producing the engine for the BD-5. There was no time allowed for what we consider to be essential and vital testing of a man-carrying aircraft and its components.

Our decision to reject the Bede Aircraft engine order in no way indicates a lack of interest by our company in the experimental aircraft market. Our engines are currently being flight tested in several applications.

KIEKHAEFER AEROMARINE D. V. THOMPSON
MOTORS, INC. DIRECTOR OF
FOND DU LAC, WIS. MARKETING

No pump

We are sorry to say this company does not sell a "two-piston open-type pump" even though we were given as a source in *How to build an air compressor for \$70* (page 140, June PM).

CANADIAN TIRE CORP. R. W. ROSE
TORONTO, ONT.

We regret that Canadian Tire Corp. was erroneously listed as one of the two sources for that pump.

Five tons, not 10

The *Hand-operated arbor press* (page 154, Sept. PM) is well designed, but the text indicating a 10-ton work capacity is perhaps an overstatement. A quick engineering stress check shows that at 10 tons, excessive stress levels occur. Sheared-off pivot pins and elongated holes could be expected. Anyone planning to operate the press at this level should plan on beefing up the design. Operating up to five tons would be the limit for the design shown.
LOS ALTOS, CALIF. J. H. McVERNON

An engineering study commissioned by PM indicates your figures are correct. "In order for this press to operate at 10 tons capacity," it states, "the following changes in design must be accomplished:

- 1. $1\frac{3}{16}$ -in.-diameter pins in lieu of $\frac{5}{8}$ -in.-diameter pins;*
- 2. Tie rod walls are to be $\frac{1}{2}$ in. thick in lieu of $\frac{1}{4}$ in.*

Surform sculpturing

I was impressed with *Now Surform makes anyone a sculptor* (page 81, Nov. PM). Surform tools play an important part in the training programs set up by the National Carvers Museum. A handicapped person is unable to use the normal inventory of carving tools without danger of injury, so he resorts to other means to shape wood. Thus, Surform is playing an important part in the rehabilitation of seriously handicapped persons.

ELIOT, ME.

WAYNE ERVIN

Thank you for the fine article. Among your subscribers, do you have any whittlers in Ohio?

NORTH OLMSTEAD, OHIO FRANKLIN SMITH

Yes. The best way to get in touch with fellow whittlers is through these two organizations: Stephen E. LePage, National Publicity Director, National Carvers Museum, Box C, Monument, Colo. 81032, and Edward F. Gallenstein, Editor, National Wood Carvers Assn., 7424 Miami Ave., Cincinnati, Ohio 45243.

The latest book by John Matthews, *Sculpture With Surform Tools*, is not being handled by St. Martin's Press. They handle all other books by Matthews, but not the latest.

WHITESTONE, N.Y.

T. J. MCCARTHY

At the time PM went to press, the editors at St. Martin's Press were sure they would be handling the new book. However, according to a spokesman, they "were not able to get together with the British publisher." Inquiries about Matthews' new book should go to Edward Arnold Ltd., 41 Maddox St., London, England.

Who has Volume 3?

I was very disappointed to learn that I cannot replace Volume 3 of *The Home Handyman Encyclopedia* because it's out of print. I would appreciate any suggestions you have for getting a copy of this volume.

READING, MASS.

STEPHEN BRYLINSKY

Any reader who has a copy to spare may write to Mr. Brylinsky, c/o Letters to the Editor. And don't forget, we do have in print the newer 16-volume Do-It-Yourself Encyclopedia for \$52.35.

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Gives objects, pictures, rooms that "glow" with eerie, psychedelic black light effect. 40 watt, 110 volt long lasting bulb. Fits any socket. Flasher makes light blink every few seconds.
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Sneak 30 to 40 feet or more in air. You control in secret. Conceal in pocket, ready to operate. Roars, Fights, Flashes, Dances, Spooky Effects. 7 1/2 feet head & body, white blood, neck, etc.
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Stop Watch 98¢
IMPORT BARGAIN - WHILE THEY LAST.
IDEA! STOP WATCH. Excellent split-second timer for non-professional events such as YOUR COME-ALONG! With no visible means of support. Sleek, 10" colorful car of the future with built-in passenger compartment. Push button control. Remote battery power pack (sold separately).
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Worth five times as much. New, authentic military shoulder patches, embroidered emblems, medals, etc. Assorted.
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PIERCES METAL. Heavy weighted & balanced point gives positive accuracy, hard hitting, deep penetration. Easy to use. Non-slip handle. Double edge, cutlery steel. X3794 \$1.25. Matched Set... 2 for \$2.25
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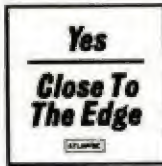
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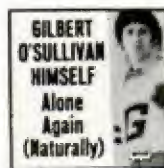
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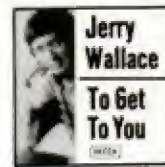
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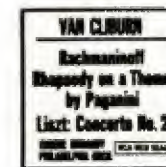
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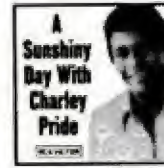
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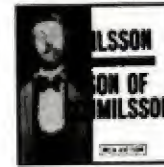
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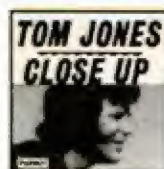
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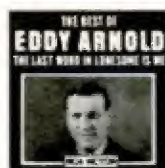
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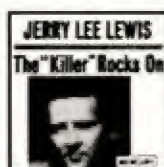
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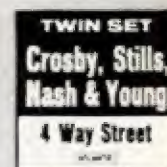
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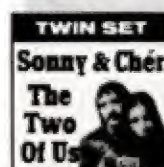
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(Please Print)

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way to earn a living.."

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In addition, you will receive a free "Demonstration Lesson" that lets you see for yourself why preparing for a more rewarding career—the ICS way—may be a lot easier than you think.

Please bear in mind, as you check off your career choice on the coupon below, that ICS has a long and distinguished record of success. In fact, more than 8,500,000 men and women have turned to ICS for career training, since 1891.

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& DESIGN
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 <input type="checkbox"/> Interior Designer
 <input type="checkbox"/> Advanced Interior Designer</p> <p>6. ELECTRICIAN
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 <input type="checkbox"/> Medical <input type="checkbox"/> Legal <input type="checkbox"/> Executive</p> | <p>8. DRAFTING
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ALL By BILL McKEOWN OUTDOORS

THE CALL OF THE OPEN ROAD this coming spring will reveal a number of new trends in recreational vehicles. Many are smaller, lighter and less expensive to own and operate. Others are bigger than ever before, with room for a lot of kids or friends. One California motor home sports a second-story observation penthouse. Another is a sort of split-level fifth-wheel triplex that extends over the pickup bed of the tow truck for a bedroom with one more step up over the pickup cab for the bed. The sturdy tow characteristics of fifth-wheelers plus all that extra space seem to appeal, but watch, too, for undersize models to match the popular little imported pickups. Both compact fifth-wheel trailers and cargo-bed camper coach bodies are now being made for them.

Bigger chassis for larger motor homes are available from all the truck companies. International has introduced a rear-engined model that is claimed to allow living space inside all on one level without the step up for driver and copilot seats or the hump that covers the engine in between. As predicted here, Mercedes-Benz is supplying the first diesel-powered chassis, and the new 25-foot Motoroam Monarch giving a reported 17 miles per gallon of diesel fuel.

Look for a lot more mini-motor homes and chopped vans. Many RV buyers seem to want to try the outdoor trend with minimum outlay to see first how they like it.

SOME LIKE IT COLD, it seems, from winter reports already in from KOA, largest of the campground chains. KOA reports over 200 of its Kampgrounds open all year, including snowbelt resort areas such as Stowe, Vt., Aspen, Colo., Sun Valley, Idaho, and Jackson Hole, Wyo. At Steamboat Springs, Colo., 175 miles west of Denver, winter campers can try downhill and cross-country skiing, snowmobiling, snowshoeing, cutter racing, ice fishing or the February Winter Carnival the second week of this month. An economical winter camping vacation no longer has to mean heading south.

FOR BOATMEN, two strong trends this year are likely to be "performance" and "preservers."

Tip-off on new higher marine horsepower came

last November at the Hennessy Cognac-Key West Race that ranks as the last event of the international championship series and the first contest for the American offshore title. In it Dr. Bob Magoon of Miami, driving an Aronow Cigarette with a pair of Carl Kiekhaefer's Aeromarine 468s, topped 73 mph average for the 189-mile run over open ocean. K.A.M. is reported to be getting over 600 hp from the 468-cu.-in. engines. With his pair, Magoon won a good head start toward his fifth consecutive national offshore title and the big No. 1 the champion can wear for the year as his racing number. The winning engines were forerunners of the Kiekhaefer Aeromarine production high-performance mills just being introduced for general use.

Outboard motor forecasts for the coming season were also previewed in November at the annual Lake Havasu City Pepsi-Cola Outboard World Championship. Factory teams from Evinrude, Johnson and Mercury showed up for the eight-hour Arizona desert event, and this year rigs were limited to single engines and tunnel-type hulls. Total distance traveled for four hours on two successive days determines the enduro winner. This time Johnny Sanders from Abilene drove his Scotti-Craft 696 miles at a record 87 mph with a Johnson Stinger for power. Over 200 hp is estimated to come from these super-tuned racing rigs, and every year more of it is passed down to regular production outboards.

Preservers are called personal flotation devices (PFDs) by the Coast Guard, but the aim is still to keep you afloat. Preferably that means with your face out of the water, even though you may have slipped on deck and knocked yourself out while falling in.

The ideal device would support an unconscious person so he would be floating slightly on his back with his head up and well supported. Flotation seat cushions with arm straps are often worn on the back and do just the opposite. They, eventually, will be phased out. The "Mae West" inflatables will probably never be officially accepted since they, too, require you to be conscious and alert to activate them.

Every person aboard any boat—and even some that aren't, like water skiers—are required to have an approved-type PFD accessible aboard the boat for them. Since different-size boats require special life preservers, it is best to check with your boat and equipment dealer to find the PFD that is legally correct for you. Eventually the strict new law is likely to save a number of lives.

WARMING FOOD is a year-round necessity but in the past many backpacker-sized stoves

(Please turn to page 22)



The number of people you can get into our boat isn't the only beautiful thing about it.

It's beautiful how many people you can sit comfortably in a tri-hull bowrider.

But, for most tri-hulls, that's where the beauty ends.

They're about as exciting to look at as an old washtub.

At Starcraft, we make our bowriders beautiful to look at as well as comfortable to sit in.

We call it Starcraftsmanship.

The standard of excellence that sets a Starcraft apart from any other boat.

And designers, engineers and craftsmen dedicated to the proposition that bowriders can be beautiful as well as practical.

Starcraftsmanship is why our 20' Capri is the best-looking tri-hull made.

It's got a white and blue exterior, a white deck and a sky-blue interior.

Inside, the Capri is loaded with luxurious features.

There's a fully instrumented automotive-type dash and steering wheel.

A removable table for dining, cards or crosswords.

A built-in beverage cooler. And storage wells molded into the stern to hold everything from ski ropes to hair spray.

Our 20' Capri seats 11.

The bow-compartment has vinyl-

covered foam seat cushions and backrests. A safety glass walk-through windshield lets you get easily from the bow to the stern. In back are reclining sleeper seats and stern seats. There's luxurious marine pile carpeting throughout.

A convertible top, tonneau covers and side curtains keep you dry when it rains. A camper top converts it to a part-time home.

But, with Starcraftsmanship, comfort only starts inside the Capri.

We designed it with our wide-stance tri-hull to give your family a safe, smooth stable ride even in rough water.

And we built it with fiberglass that's not only beautiful but pound for pound stronger and more durable than steel. To give you years of maintenance-free operation.

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Our high resale values. Service from our 1200 dealers and 30 distributor service centers.

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Or write to the Starcraft Company, Dept. G29-2, Goshen, Indiana, 46526, for further information.

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ALL OUTDOORS

(Continued from page 20)

were compact and inefficient. Now several make sense and plenty of heat. Primus has a little stove, heater and light operating from a small can of LP-gas and stowing snugly in a backpack. One Gerry model opens to use LP, while a doughnut-shaped pocket model with its fuel inside, stays lit in a wind but shuts off automatically if turned over.

Campers with an eye for color should like two-tone tents introduced this spring by Sears, Roebuck and Wenzel. European campgrounds still show the most color per foot of campspace but domestic tentmakers are catching up.

Outdoor action abroad seems to be the goal of many campers, according to a lot of letters we have recently received. Most countries supply good campground information and often hunting and fishing data through their consulate tourist offices in Washington and New York. For RV touring in Europe, write Wilsons Motor Caravans, 36 Acre Lane, London, S.W.2, England, for info.

A photo safari in Africa that includes an Avis car with unlimited mileage for tracking down animals is provided by Swissair and E-Car Tours. Braniff Airlines also plans special sportsman tours in South Africa. Details are available from the carriers involved.

BOATING BASS is becoming such a big sport that tournaments are already being scheduled throughout the coming summer. Last year's big winner at the Bass Masters Classic, sponsored by the Bass Anglers Sportsman Society (B.A.S.S.), was Don Butler of Tulsa, Okla. His first place on Percy Priest Reservoir near Nashville, Tenn., also netted him \$10,000. James Trewick Jr., of Abbeville, Ala., took the Evinrude Bass Buster Tournament top spot on fabled Toledo Bend Reservoir, Hemphill, Tex. And at the All-American Bass Tournament on Lake Eufala, Roland Martin, Tulsa, Okla., caught and released 30 pounds of bass the first day to help haul in his win.

WISE OUTDOORSMEN can learn a lot free or at minimum cost from catalogs. Occasionally an exceptional one comes along, and our unofficial award goes to Wolverine Shoes of Rockford, Mich., for a set of bound-in photos by famous outdoor photographer Ansel Adams, as a salute to him on his 70th birthday. Runner-up catalog kudos should probably go to Sierra Designs for its display of new equipment photographed in the California ghost town of Bodie, and to Silverline Boats for pages that show some of the special pleasures of days on the water. ★★★

WHEN YOU NEED A NEW BATTERY, THINK OF THE ONE GM STARTS WITH.

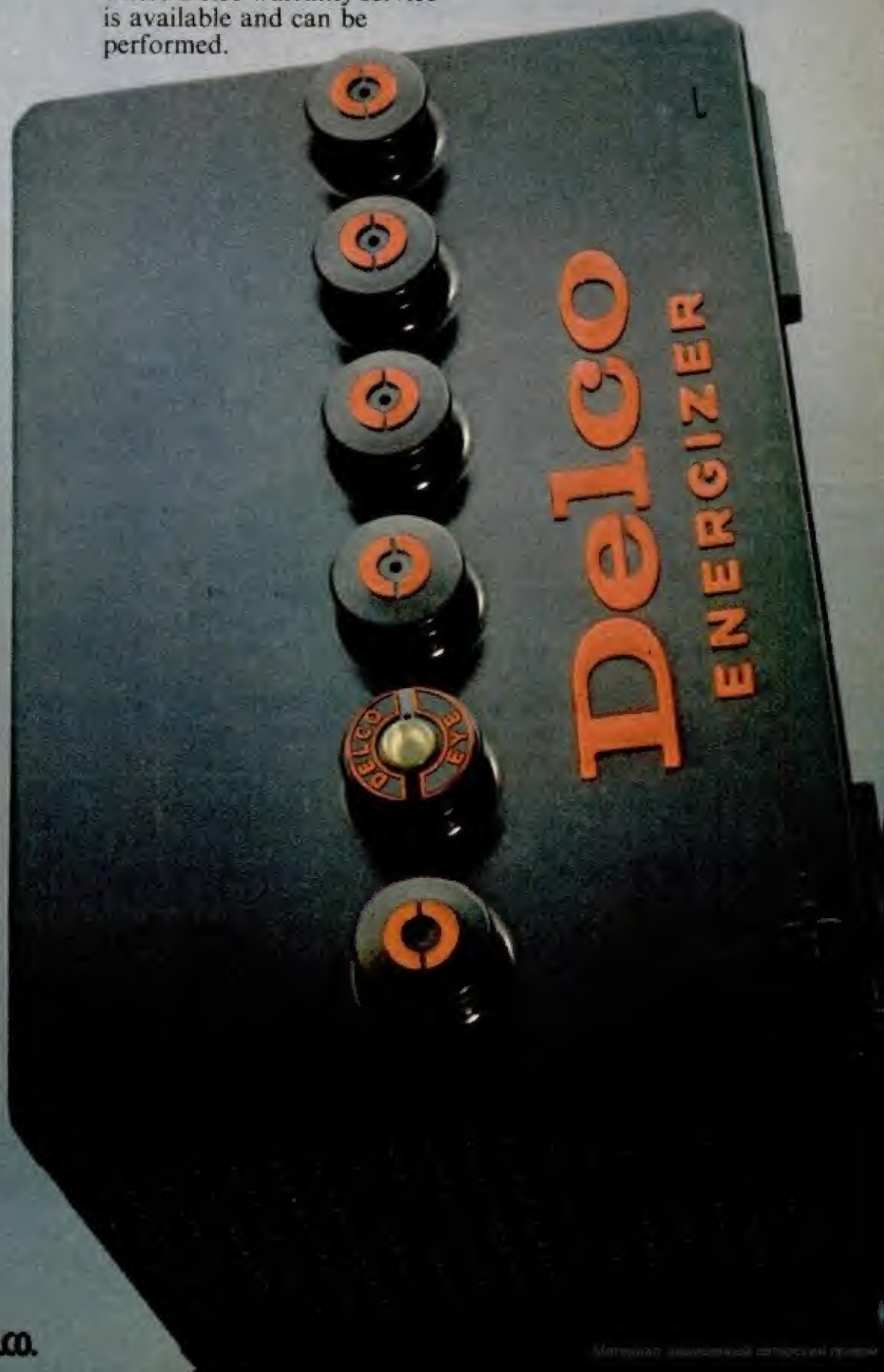
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Get the battery GM starts with.

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DETROIT

LISTENING POST

BY ROBERT LUND

AMC READYING NEW MINI. Assuming GM can supply the engines, American Motors could have a Wankel-powered minicar—smaller than Gremlin—on the road as early as 1975, carrying a 1976 model designation. The car itself is almost ready to go. It's being tested and the company is looking at prices on tooling. If GM can't supply the Wankels by mid-summer of 1975, AMC may go ahead with the car, using an existing engine, and offer the Wankel at a later time, when rotaries become available from GM or elsewhere.

GM RESTYLING STANDARDS. Lion's share of the money GM's allocated for styling changes this year will go into new bodies for the standard-size cars. On the outside, the cars will get new roofs and new metal front and rear. On the inside, GM's expected to go to a more masculine look, like the Levi trim used in American Motors' Gremlin. But that's only a for instance, because GM won't use the same cloth used in Gremlin.

CADILLAC-CORVETTE MERGER? Some GM-watchers figure it'd be a smart move if GM pulled two cars off the new body being worked up for Corvette. A new Vette for one and the long-promised junior car from Cadillac for another. To swing this, Corvette would probably have to drop its fiberglass body—unique among Big Four cars—and go to metal. This ties in with GM's goal of getting maximum mileage out of its bodies, of building several "makes" of cars



COMPACT, ECONOMY CARS don't have to look that way. Among new dealer options to give compacts the muscle-car look is this front styling option for Pontiac Ventura and Ventura Custom. Does the twin-grille remind you of the Firebird? That's the point

off the same shell. All of which makes a neat package of conjecture. But at this point, we'd still bet the cut-down Cadillac with (1) share a body with another GM car, other than Corvette or, (2) emerge as a luxury, Americanized version of a new Opel.

BIG ENGINE FOR BIG FORDS. Ford's prepping a more powerful engine for its big ticket cars—Mark IV, Lincoln and Thunderbird. Company hopes to have it ready by fall, in time for the '74s. But if the plant can't be put into volume production in time for '74 introductions, the first part of the run will probably go into Mark IV, with Lincoln and Thunderbird getting the unit later as production revs up.

THOSE SERVICE PROGRAMS the auto companies launched with such fanfare last fall that were supposed to make it easier to get your car fixed—actually no more than you're entitled to under the warranty—are already bearing fruit. But for the carmakers, not the customers. The service mess hasn't improved two cents worth. But there's already talk of using the service programs as pegs for advertising campaigns to tell the public what a great shake they're getting on service. The big-shooters in Detroit who are in a position to do something about service don't know what it's like to have a car repaired in the real world. In the first place, they drive company cars. After 3000 miles or three months, they turn the "old" car in for a new one. But if they have a problem, it's fixed at the factory garage. No pain, no strain, no waiting, no charge.

COMEBACK OF THE FUN CAR. You've read about the new engines Detroit's working on and the great gobs of gear coming on cars to make them safer and to curb pollution. But what about the fun stuff? Not engines, not by-decree devices the government says you have to take because they're good for you. But fun features to make driving easier, more exciting, more pleasant, less of a drag and more of an adventure.

The word from here is wait a couple years. Insiders at the auto and supplier companies say there's a whole phantasmagoria of fancies coming in 1975 and '76. Nobody will say what the

(Please turn to page 27)

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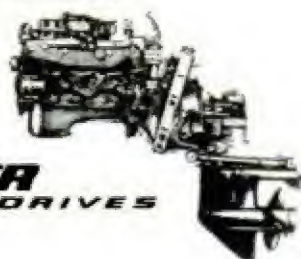


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DETROIT LISTENING POST

(Continued from page 24)

surprises will be, what they'll do, how they'll be used, although many of them apparently involve use of electronics. But they'll be for the good times and the pleasure of it and not basics, like engines, and not castor oil equipment mandated by government.

Why the sudden spurt of creativity by car-makers? And if Detroit really has a box of surprises, why should it take two to three years to get them out?

It's not as if somebody issued a command to invent and the marvels came pouring out of a tap. Many of the innovations coming on cars in the next few years have been in development since 1966, when the government stepped in to regulate the industry. This was a new experience for Detroit. The industry had never been regulated before. For the past six years, car-makers say they haven't had the time, manpower or facilities to pursue nonessentials. The fun stuff had to go on the back burner. Detroit still isn't certain how it's going to handle the antipollution goal the government's set for mid-decade. But other than that, the industry feels it's in good shape in satisfying government requirements. It's learned to live with regulation and is beginning to see ways of integrating government objectives with the total vehicle.

Two more years and automakers figure they'll be in a position to get back to the baubles and imagination stuff. Build cars that won't foul the air and combine safety with *joie de vivre*.

TESTS FOR MECHANICS. This is for readers who have asked for more information on tests for mechanics (see *Detroit Listening Post*, Oct. '72 PM). There are four tests and each one costs \$10—a total of \$40. But you don't have to sign up for all four—you can take just those you want. You take them one at a time, not all four at one shot. To find out when the next test will be given in your area, write Certified Mechanic Program, Box 2611, Princeton, N.J. 08540.

CHRYSLER SEEKING WANKEL SOURCE. Despite its blasts against the Wankel, Chrysler has scouts in Europe and Japan shopping to see what's available in the way of Wankel capacity should the company decide to offer a rotary on a token basis. So Chrysler dealers can say, "We've got one, too." This is just a foot-in-the-door arrangement and shouldn't be interpreted to mean Chrysler's wavering on its conviction that the Wankel will be a short-term proposition in the United States. ★ ★ ★

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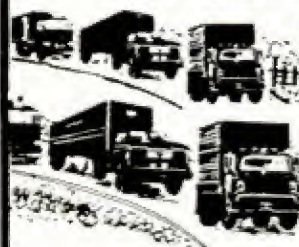
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Test run for Martian sampler

IF THE VIKING MARS VEHICLES land in good shape, they will deploy booms capable of scraping samples of Martian soil and transferring them to processing units for chemical and biological analysis. Results of the tests will be radioed to scientists in the United States. Models of the sampling mechanisms are now undergoing tests at the Martin Marietta Aerospace plant in Denver. The Viking program calls for two unmanned spacecraft to land on Mars in 1976.

IN SEVERE STORMS, some tall buildings sway with sufficient force to cause occupants to suffer from motion sickness, according to Robert J. Hansen, an MIT engineer. Designers should test models of their buildings in wind tunnels, says Prof. Hansen, "and if the building response is inadequate, the building should be redesigned."



Installing bite-size receiver

HEARING THROUGH YOUR TEETH is made possible by a miniaturized system developed by University of California scientists. A transmitter-receiver—worn on the body or carried in a pocket—picks up the sound signal and transmits it to a receiver installed in the mouth. Tiny enough to be inserted in a false tooth, the receiver drives sound impulses through the bones of the upper jaw to the inner ear. Research has shown that teeth are better conductors of sound than are the bone structures behind the ear, where some hearing aids are worn. The new device could be used to help some victims of hearing loss, or to cue actors or signal athletes in certain sports.

EASTERN NORTH AMERICA IS OVERDUE for a big earthquake if past history is used as an indicator. That's the opinion of Pennsylvania State University's Dr. B.F. Howell Jr., a geophysicist who explains that there have been "four damaging earthquakes in the region every 50 years for the last 200 years." The last occurred in 1944, causing \$2-million in damage in and around Massena, N.Y. The next eastern quake, according to Dr. Howell, may occur within 400 miles of the Appalachian Mountains, within an area extending from the coast to points as far inland as Chicago.



Fuel capsule goes into cooler

FIRST USE OF NUCLEAR ENERGY to operate a refrigerator was recently demonstrated by the Atomic Energy Commission and the Hughes Aircraft Co. The nine-pound unit, which can provide spot cooling as low as minus 320°F., is designed to cool microwave, laser and radiation detection systems. The device is similar in concept to a gas refrigerator in that cooling is pro-

(Please turn to page 30)

TOUGH!



Another reason you can rely on AC... the "electrical test"

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AC Fire-Ring Spark Plugs . . . built tough, tested tough to help assure you quick starts and a smooth-running engine.

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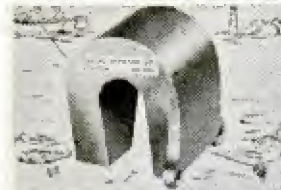
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Thrill to the fun of building your own see-through motorized model of revolutionary pistonless type engine... only engine experts think economically modifiable to meet new pollution standards. Replaces piston, cylinder, crank assemblies with rotating discs (sections removed for firing chambers). Smaller than conventional; fewer parts, greater reliability, same speed w/less horsepower. Feat: flashing plugs, rubber fan belt, stick-shift on-off switch. Req. 2—1.5V batt. (not incl.).

(4½"X5"X9") \$6.75 Ppd.

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Build big ¼ scale see-thru motorized wkg model of the 4-cyl engine that makes 750 Four most advanced motor-cycle on the mkt. 68 hp. engine that won Daytona revs up to 8000rpm, top speed over 125 mph. Feat: overhead cam 4-stroke engine design; 4 synch carbs, 4 up-swept mufflers, & hemi heads with offset valves. Shows valve opening & closing, piston cycle, flashing plugs, etc. 187 metal & plastic pre-colored parts, display stand, instrs. Req. 2 "AA" Batt (not incl.).

Stock No. 71.750H \$12.95 Ppd.

AMERICAN MADE OPAQUE PROJECTOR



Projects illustrations up to 3" x 3½" —enlarges them to 35" x 30" if screen is 6½ ft. from projector, larger pictures if screen is farther away. No film or negatives needed. Primarily intended for children. Projects charts, diagrams, color or black-and-white in darkened room. 115 v. A.C. . . . 6 ft. cord and plug included. Size 12" x 8" x 4½" wide. Weight 1 lb. 2 ozs. Plastic case.

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SCIENCE WORLDWIDE

(Continued from page 28)

duced from a heat source. Heat is produced by decaying radioisotopes in capsules containing plutonium-238—a fuel supply that's good for more than 85 years. The Nuclear refrigeration is planned only for space applications.

The environment

IT SEEMS MANURE can have a variety of smells. The goal of an unusual research group in Sweden is to determine the least offensive form of manure for use by farmers. The research team is composed mainly of women. Some work in a specially



equipped bus, an "atmosphere laboratory," while others sit in fields at "smelling stations." When a trailer loaded with manure passes, they compare its odor with that of control samples.

BIRDS EXPOSED to a San Francisco Bay oil spill in 1971 died from ingesting large amounts of oil or from infections and stress related to their exposure and handling. Those are the conclusions of a Stanford University medical team that examined tissues and organs of 119 birds that had died after being brought to the San Francisco Zoo for cleaning. Sea birds ingest oil when they clean their feathers.

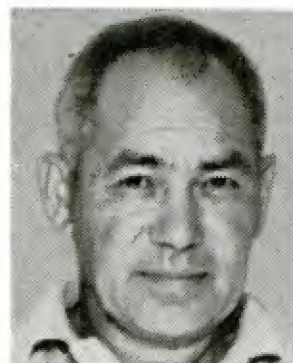
FIVE TIMES EACH MINUTE, scientists at Argonne (Ill.) National Laboratory transmit a narrow beam of sound into the air to study the structure of the lower atmosphere. The "acoustic radar" draws a continuous picture of the atmosphere over the laboratory site to a height of 6000 feet. The picture shows temperature inversion layers that allow a buildup of pollutants which can be hazardous to health. ★★

when I planned to retire before fifty

this is the business that made it possible

a true story by John B. Haikey

Starting with borrowed money, in just eight years I gained financial security, sold out at a profit and retired.



"Not until I was forty did I make up my mind that I was going to retire before ten years had passed. I knew I couldn't do it on a salary, no matter how good. I knew I couldn't do it working for others. It was perfectly obvious to me that I had to start a business of my own. But that posed a problem. What kind of business? Most of my money was tied up. Temporarily I was broke. But, when I found the business I wanted I was able to start it on a little over a thousand dollars of borrowed money.

"To pyramid this investment into retirement in less than ten years seems like magic, but in my opinion any man in good health who has the same ambition and drive that motivated me, could achieve such a goal. Let me give you a little history.

"I finished high school at the age of 18 and got a job as a shipping clerk. My next job was butchering at a plant that processed boneless beef. Couldn't see much future there. Next, I got a job as a Greyhound Bus Driver. The money was good. The work was pleasant, but I couldn't see it as leading to retirement. Finally I took the plunge and went into business for myself.

"I managed to raise enough money with my savings to invest in a combination motel, restaurant, grocery, and service station. It didn't take long to get my eyes opened. In order to keep that business going my wife and I worked from dawn to dusk, 20 hours a day, seven days a week. Putting in all those hours didn't match my idea of independence and it gave me no time for my favorite sport—golf! Finally we both agreed that I should look for something else.

"I found it. Not right away. I investigated a lot of businesses offered as franchises. I felt that I wanted the guidance of an experienced company—wanted to have the benefit of the plans that had brought success to others, plus the benefit of running my own business under an established name that had national recognition.

"Most of the franchises offered were too costly for me. Temporarily all my capital was frozen in the motel. But I found that the Duraclean franchise

offered me exactly what I had been looking for.

"I could start for a small amount—a little over a thousand dollars—and that amount I could borrow. I could work it as a one-man business while getting a start. No salaries to pay. I could operate from my home. No office or shop rent or other overhead. For transportation I could use the trunk of my family car. (I bought the truck later, out of profits.) But, best of all, there was no ceiling on my earnings. I could build a business as big as my ambition and energy dictated. I could put on as many men as I needed to cover any volume. I could make a profit on every man working for me. And, I could build this little by little, or as fast as I wished.

"So, I started. I took the wonderful training furnished by the company. When I was ready I followed the simple plan outlined in the training. During the first period I did all the service work myself. By doing it myself, I could make much more per hour than I had ever made on a salary. Later, I would hire men, train them, pay them well, and still make an hourly profit on their time that made my idea of retirement possible—I had joined the country club and now I could play golf whenever I wished.

"What is this wonderful business? It's Duraclean. And, what is Duraclean? It's an improved, space-age process for cleaning upholstered furniture, rugs, and tacked down carpets. It not only cleans but it enlivens and sparkles up the colors. It does not wear down the fiber or drive part of the dirt into the base of the rug as machine scrubbing of carpeting does. Instead it *lifts* out the dirt by means of an absorbent dry foam.

"Furniture dealers and department stores refer their customers to the Duraclean Specialist. Insurance men say Duraclean can save them money on fire claims. Hotels, motels, specialty shops and big stores make annual contracts for keeping their carpets and furniture

fresh and clean. One Duraclean Specialist recently signed a contract for over \$40,000 a year for just one hotel.

"Well, that's the business I was able to start for a little over a thousand dollars. That's the business I built up over a period of eight years. And, that's the business I sold out at a substantial profit before I was fifty."

Would you like to taste the freedom and independence enjoyed by Mr. Haikey? You can. Let us send you the facts. Mail the coupon, and you'll receive all the details, absolutely without obligation. No salesman will ever call on you. When you receive our illustrated booklet, you'll learn how we show you STEP BY STEP how to get customers; and how to have your customers get you more customers from their recommendations.

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APPLIANCE CLINIC

By PAUL MANN

Germ of an idea

My Hamilton automatic gas clothes dryer is about 10 years old. The bulb which lights when the door is opened blew out. I replaced it with one of the same kind—a 40-watt appliance bulb. The new bulb doesn't go on. Where's the problem?—Harlen Underwood, Providence, R. I.

There is a second bulb—a germicidal lamp—in the circuit which is wired together with the door bulb. When one goes bad, the other won't go on. The germicidal lamp creates the flashes of light you see as the drum revolves. In Hamilton dryers that are "about 10 years old," the germicidal lamp is positioned in a housing right next to the door bulb. Replace the germicidal lamp and both will probably now work.

Soft food on the door

We have a Ward's Signature side-by-side refrigerator-freezer combination about a year old. When the outside temperature is over 85°, articles stored on the door of the freezer, such as hot dogs, buns and orange juice, soften considerably. Roasts and steaks in the main cabinet remain hard. A repairman has told me that the unit is in good condition. Is he right?—Mrs. B. Ramsden, Arlington Heights, Ill.

I would say so. Food kept on a freezer door has a tendency to remain "softer" than foods kept in the main cabinet. This is more pronounced and more noticeable during warm weather. There are no refrigerating coils in a freezer door as there are in the main part of the unit. Food kept on the door, therefore, must rely on "residual cold" passed to it from the main part of the freezer. Try setting the unit on a colder setting or move food from the door to the main cabinet until the warm weather subsides.

Rusting stove

We bought an O'Keefe & Merritt stove

about three years ago, but are very disappointed because components (chrome, side panels, racks and surface) are rusting. The manufacturer has told us the condition is caused by our climate and claims there is nothing he can do. Is he right?—M. Palmisano, Metairie, La.

Appliance Clinic has obtained two different theories regarding this problem. One leading manufacturer of stoves told us this problem is neither unique nor confined to your type of area, but it is nationwide. He contends that climate has nothing to do with it, but that heat from the pilot assembly gets trapped beneath the main deck, because vent holes are "too small." Trapped heat causes condensation that leads to rusting.

"There is nothing you can do," a representative of this company says.

Public Service Electric and Gas Co. of New Jersey disagrees. A representative contends that the 2 by 6-inch vent slot in the rear of the stove that allows heat to escape was either not blanked out at the factory or has been inadvertently plugged up. Make sure this vent is open.

In addition, Public Service says, it's a good idea to leave the door of the stove open a bit the first four or five minutes of preheating to let moisture escape.

'Building' a new housing

My Whirlpool automatic clothes washer is equipped with the brush filter. I want to replace a damaged filter housing, but would not like to tackle the task without having a clear understanding of how to do it. Can you help?—Thomas Danberry, Franconia, Va.

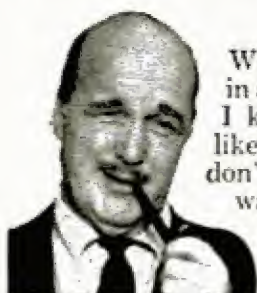
Easy enough. The brush filter assembly housing is held in the top of the washer by a gasket that has to be dislodged. Start by removing the brush filter itself—a task you should be familiar with since this should be done to clean the filter after every wash. With a screwdriver, carefully dislodge and push the gasket through the top of the washer. This frees the filter housing.

To install the new housing position the gasket on the bottom ridge of the housing and push the assembly into place from the underside of the top.

Dirty dishes

Our Tappan model 61-0016 dishwasher
(Please turn to page 34)

TOM McCAHILL says: "If your pay check's thinner than a 10 cent hamburger...fatten it up by earning extra money repairing appliances."

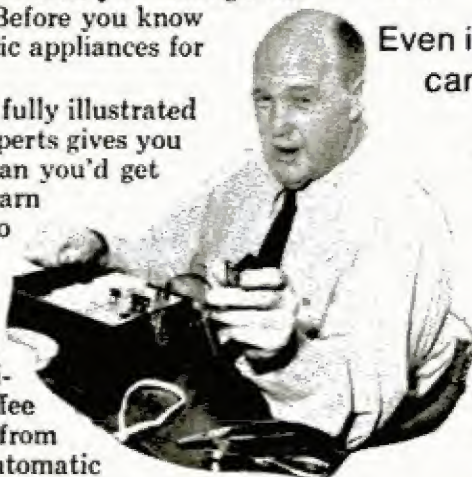


When a fellow tells me his wallet's in about the same shape as my hair, I know how he feels. Salaries are like \$50 Caribbean cruises . . . they don't go very far. But I know one way a guy with get up and go can make himself some real money . . . by learning Appliance repair.

Earn \$5 to \$7 an hour in your spare time.

NRI has a low-cost, home study plan that covers every type of Appliance repair in detail. Even if you're all thumbs and don't know a soldering iron from a steam iron, NRI can lead you through the course one step at a time. Before you know it, you'll be servicing electric appliances for cold, hard cash.

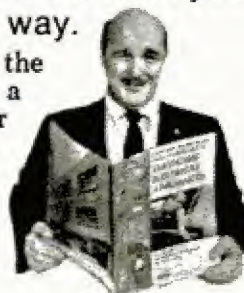
The lessons come to you fully illustrated . . . and the NRI staff of experts gives you more personal attention than you'd get in many classrooms. You learn basic electricity and how to use test instruments, at your own speed. The course covers the electrical and mechanical operation of every type of appliance from toasters and coffee makers to dishwashers; from vacuum cleaners and automatic laundry equipment to air conditioning and refrigerators.



They even show you how to fix farm and commercial appliances and small, one-lung engines. Their staff of experts work with you every step of the way. NRI even includes a professional Appliance tester in the low tuition.

Turn off the TV and learn at home in your spare time, the easy NRI way.

You won't make a buck off the boob tube, but you can make a bundle in the Appliance repair field. (If you're really out to learn, they've got a special course on air-conditioning and refrigeration repair, too.)



Even if you can't wire a plug, NRI experts can teach you all you need to know.

Thousands of guys like yourself have studied with NRI, and they all had one thing in common. They were looking for a way to learn a new skill that would pay off. The Appliance Division of NRI can teach you that skill. Just send in the coupon below for the free catalog that gives you all the details. Send it today and they'll have the book in your hands in no time. Then, it'll be up to you. No salesman will call. The only knocking you'll hear will be opportunity.

Tom McCahill

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If you served since January 31, 1955 or are in service, check GI line below.

APPLIANCE CLINIC

(Continued from page 32)

doesn't run—no hum, nothing, dead. Is the motor burned out?—Raymond Greenberg, Asbury Park, N.J.

Check the two most common reasons for this trouble: a blown fuse or tripped circuit breaker, and an improperly adjusted or defective door switch. If the circuit is protected by a fuse, be certain that the correct fuse is being used—specifically, a 15-amp. slow-blow type.

The door switch is positioned within the door panel, directly behind the latch. The switch is activated by the door latch strike. After removing the control panel, bend the switch arm a bit and see if the dishwasher will run. If not, the door switch has probably gone bad and should be replaced by disconnecting the wires (pull the plug from the outlet, or remove the fuse or trip the circuit breaker before you do) and unscrewing the switch. You can get a new switch from a Tappan dealer.

Water, water everywhere

I am getting water puddles on the in-

Try the tub fixer

from



DAP KWIK-SEAL®. A bright white tub and tile caulk that seals joints and cracks watertight around tubs, sinks, showers, tiled areas. Beautifies bath and kitchen. Stays flexible. Resists mildew.

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side of my Hotpoint refrigerator. Why?
—J. Domituovits, Catasauqua, Pa.

If the unit is a nonfrost-free type, there may be an air leak because of a bad seal or warped door. To check the seal, place a dollar bill in the door and shut it. If there is no resistance as you pull the bill from the door, the seal is faulty or the door is warped. Do this around the entire door.

To straighten a warped door, the inner door panel should be unscrewed from the outer door panel, and the outer door panel must be twisted.

If the unit is a frost-free model, puddles will result if outside drainage is impeded by a clogged drain. Some models have drain holes that can be reamed out . . . a drill bit makes a suitable reamer. If the model has a long drain tube instead of drain holes, a snake-type device will have to be used to clean it out. An old speedometer cable serves nicely. ★★

If you have a question about any appliance, send it to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. However, problems of widest interest will be answered in this column.

Chrysler makes it easy to leave your everyday world behind.



Get away from the noise, the crowds, the hustlebustle of the workaday world. Forget the pressure, tension and hectic pace.

Chrysler makes it easy to leave it all behind. And enter a refreshing new world.

A world that's serene and silent as a moonbeam dancing on a wave. Or sizzling with the excitement of a speeding pair of skis kicking up a spray.

Take command of the watery world that awaits you. It's easy. With Chrysler.

Chrysler Hi-Performance: Engineered to make things easy.

Get away from the everyday — far away. Head for the horizon. Water ski. Fish for the big ones on the outer limits. Chrysler's Hi-Performance line of dependable 1973 outboards makes it easy.

Five exciting outboards, starting with the 3-cylinder action of the 70 and working up to the most horsepower you'd want to hang on most any popular-sized boat — the sizzling 4-cylinder 130. In between, you've got the 85, America's most powerful 3-cylinder outboard, and two more 4-cylinder models, the 105 and 120.

They're all Chrysler engineered to make things easy. Easy starting with Magnapower C-D ignition. Easy going with a new remote-



control cruise range indicator for maximum economy, a new fastback leg design with big 14" prop capability, and cleaner, more attractive styling. Easier servicing with new integrally designed 2-stage fuel pump, too.



They're also easy on the environment. Complete fuel recycling helps keep the water clean, and super-silencing helps keep the peace and quiet.

And if you're the kind of boater who likes the ultimate in easy operation, Chrysler's Power Trim/Power Tilt option adds a new dimension of performance to the Hi-Performance line. Tilt and trim functions are at your instantaneous command, operating off a single switch.

Power Trim lets you trim motor under power for optimum performance and Power Tilt allows you to raise it full-up for beaching, trailering, or shallow water operation at low speeds.





HI-PERFORMANCE SPECIFICATIONS

	130	120	105	85	70
Cert. BIA hp. @ rpm	130 @ 5250	120 @ 5250	105 @ 5000	85 @ 5000	70 @ 4750
No. of Cylinders	4	4	4	3	3
Piston Displacement, cu. in.	96.55	96.55	96.55	72.39	72.39
Net Weight, lbs.	250	248	248	221	221
RPM Range — full throttle	5000-5600	5000-5500	4500-5500	4500-5500	4400-5100
Ignition	Magnapower	Magnapower	Magnapower	Magnapower	Magnapower
Amp. Output @ rpm	10 amp. @ 4000	10 amp. @ 4000	10 amp. @ 4000	10 amp. @ 4000	10 amp. @ 4000
No. of Carburetors	2	2	2	3	3
Std. Prop Dia. X Pitch; Number of Blades	13 x 17; 3	13 x 17; 3	13 x 17; 3	13 x 15; 3	13 x 15; 3

Chrysler makes it easy to get family plans off the ground.

If fishing's not fast enough and racing's not your style, Chrysler has a complete choice of mid-range power that makes it easy to plan your kind of family fun.

These Chryslers will let you go the limit from ski to cruise, from wide open to trolling speed. And you've got a pick of power ranging from 35 to 55 horsepower in 24 different models.

Over the years Chrysler 35's have proven themselves consistent winners in national APBA powerboat racing. The versatile 45 provides high performance at a medium price. And the 55 offers the highest BIA-certified 2-cylinder horsepower rating you can get. Anywhere.

Underneath those handsome new fiberglass hoods, Chrysler Mid-Ranges are engineered to make life easy with new features like built-in rear handles for easier tilt up, new upper gear housing for more efficient cooling and an integrally designed fuel pump for easier maintenance. And the 45 and 55 are available with Magnapower C-D ignition, Chrysler's exclusive ignition system that assures quick starts even in freezing temperatures or with a weak battery.

And, of course, they're all Chrysler engineered to take it easy on the environment. With greatly improved silencing to keep things calm and fuel recycling and dripless carburetors to keep the water clean.



MID-RANGE SPECIFICATIONS

	55 MAGNAPOWER	55	45 MAGNAPOWER	45	35
Cert. BIA hp. @ rpm	55 @ 5250	55 @ 5250	45 @ 4750	45 @ 4750	35 @ 4750
No. of Cylinders	2	2	2	2	2
Piston Displacement, cu. in.	44.7	44.7	42.18	42.18	35.9
Net Weight, lbs.*	151	148	151	148	148
RPM Range—full throttle	5000-5500	5000-5500	4400-5100	4400-5100	4400-5100
Ignition	Magnapower	Batt. Mag.	Magnapower	Batt. Mag.	Batt. Mag.
Charging System	Alt.	Alt. None	Alt.	Alt. None	Alt. None
No. of Carburetors	1	1	1	1	1
Std. Prop Dia. X Pitch; Number of Blades	10-3/8x12- 1/2; 3	10-3/8x12- 1/2; 3	10 3/8x12- 1/2; 3	10-3/8x12- 1/2; 3	10-3/8x11- 1/2; 3
*alternator model.					



Chrysler makes it easy from every angle.

Everything's easy with Chrysler Lo-Profiles. Their low, transom-hugging design makes it easy to cast a line in any direction. Their light weight makes them easy carry-outs. Fold-up-down tillers make them easy stowaways. And features like curved, weed-free legs, self-releasing choke and no-shearpin props make them easy to enjoy.

It's the only full line of lo-profile outboards on the market. With 6, 8, 9.9 and 12.9 horses to choose from. The goingest, quietest, most compact power on the water.

The Lo-Profiles are powered to do the job, whether it's quiet, steady trolling, bringing a sailboat back to shore, moving a fisherman to his favorite spot fast, or just plain fun-running. Chrysler's shallow-water drive keeps you going in as little as six inches of water. And the forward-neutral-reverse gearshift and front-mounted controls make for easy handling.

And even though the Lo-Profiles are lightweight and compact, we still found room enough to build in Chrysler's fuel recycling system to help make your boating good clean fun.

Chrysler's big little 3.6-hp. "Swinger" is proof positive that good things come in small packages. Just 33 lbs., the very portable

"Swinger" is nevertheless loaded with outstanding features: simple air-cooled design with water-cooled exhaust; stainless steel shaft; dripless carburetor; heavy-duty prop hub and shearpin; 360° pivot

steering; self-relieving choke; built-in carrying handle, and much more. It's perfect for breaking in the youngsters, unbecalming a sailboat or getting the canoe or rowboat back upstream.





LO-PROFILE SPECIFICATIONS

	12.9 AUTOELECTRIC	12.9	9.9 AUTOELECTRIC	9.9	8	6	3.6
Net. BIA hp. @ rpm	12.9 @ 5000	12.9 @ 5000	9.9 @ 4750	9.9 @ 4750	8 @ 5000	6 @ 5000	3.6 @ 4500
No. of Cylinders	2	2	2	2	2	2	1
Station Displacement, cu. in.	13.62	13.62	13.15	13.15	10.2	8.99	5.18
Net Weight, lbs.	77	59	74	56	49	47	33
RPM Range — at full throttle	4500-5500	4500-5500	4300-5200	4300-5200	4500-5500	4500-5500	4000-5000
Fuel Tank — w/Gauge	6 U.S. gals. steel	6 U.S. gals. steel	6 U.S. gals. steel	6 U.S. gals. steel	6 U.S. gals. steel	6 U.S. gals. steel	Integral 7 U.S. pints
Propeller Drive	Shearproof spline	Shearproof spline	Shearproof spline	Shearproof spline	Shearproof spline	Shearproof spline	Shear pin
Std. Prop Dia. X Pitch:	8-1/8 x	8-1/8 x	8-1/4 x	8-1/4 x	7-1/2 x	8 x 5;	7-1/2 x
Number of Blades	8-1/4; 3	8-1/4; 3	8-1/4; 2	8-1/4; 2	6-1/2; 2	2	4-1/2; 2

Want a little more power for a lot more fun? Chrysler's new 25 and 30 make it easy.

Boaters have been looking for a modern outboard in this power/performance/price range for years.

Now Chrysler makes it easy for you with two brand-new 2-cylinder outboards that let you do a lot more on water. Surprisingly lightweight and compact, they still pack enough punch to take you fishing one minute and skiing the next. Combined with the quiet-running 20, you've got a wider choice of power than before.

And they're loaded with Chrysler-engineered



features that make the going easy. Heavy-duty components. Water-cooled heads. Full gearshifts. Integrally designed 2-stage fuel pumps. Push-to-stop buttons. All topped off with handsome fiberglass hoods with built-in tilt handles.

The 25 and 30 are both available in manual and electric start models with standard or long shaft. See them at your Chrysler Crew dealer today. Then try one on your transom tomorrow.



30 25 20 SPECIFICATIONS

	30	25	20 AUTOELECTRIC	20
Cert. BIA hp. @ rpm	30 @ 5000	25 @ 5000	20 @ 5000	20 @ 5000
No. of Cylinders	2	2	2	2
Piston Displacement, cu. in.	29.99	28.57	19.96	19.96
Net Weight, lbs.	113	105	103	79
RPM Range—full throttle	4500-5500	4500-5500	4500-5500	4500-5500
Ignition	Magneto	Magneto	Magneto	Magneto
Charging System	None	None	Starter-generator	None
No. of Carburetors	1	1	1	1
Std. Prop Dia. X Pitch; Number of Blades	10-3/8 x 13-1/2: 3	8-1/2 x 10; 3	8-1/2 x 8-1/2: 3	8-1/2 x 8-1/2: 3

FREE. At your Chrysler Crew dealer's.

**The 1973 Buyer's Guide:
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Everything you ought to know about
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- What to look for in boat construction.
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MARINE PRODUCTS



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Smokey/Frolic/Grizzly/Volunteer/Norris/Travelmaster/Ken-Craft

- It's lighter and stronger . . . Thermo-Core laminated sidewall construction makes it that way.
- Frolic is more roadable . . . the Cushion-Torque suspension absorbs bumps independently and reduces sway.
- It's roomier . . . Frolic's spacemaker frame gives you a large unobstructed floor space.
- Frolic contour seats are comfortable . . . they fit the sitting position more naturally.
- Mortise and tenon cabinets are standard! They won't separate like conventional cabinets with varying climatic conditions.

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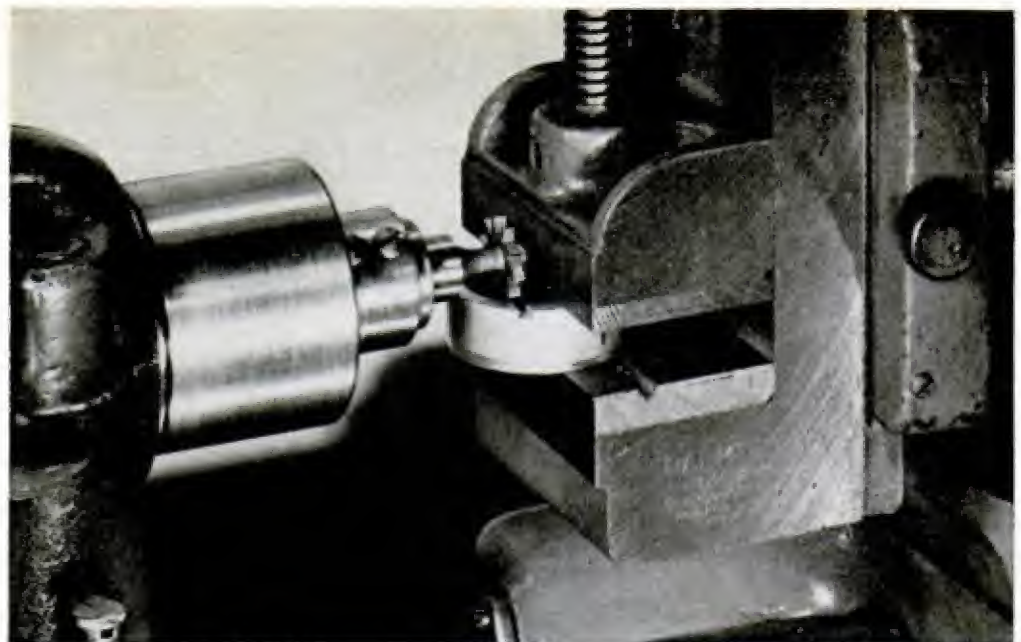
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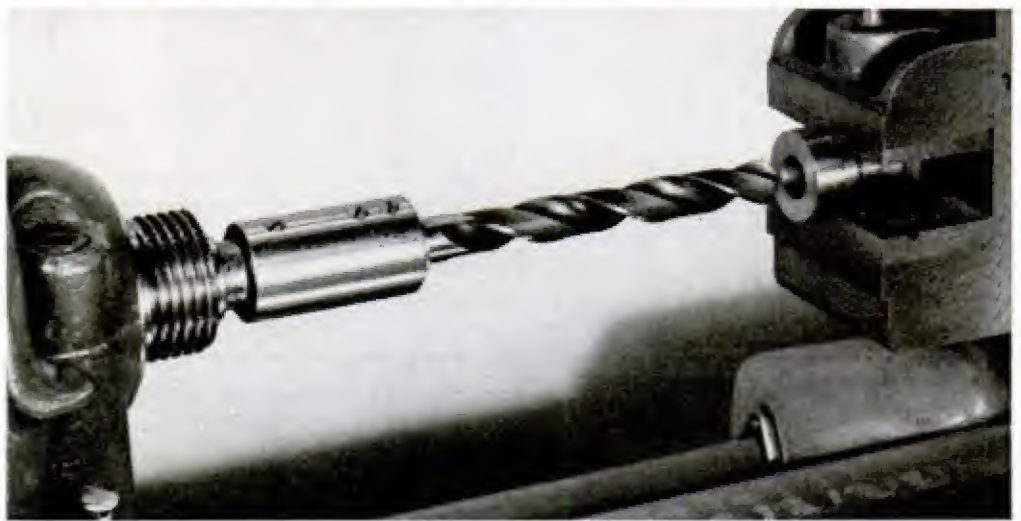
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MOUNTED in screw-on setscrew chuck (top photo), a Woodruff keyway cutter is used to slot a ring. Work is held in carriage-mounted milling attachment. Taper-shank setscrew chuck (bottom photo) is better suited for drilling and other operations in which the pressure is mostly lengthwise



Setscrew chucks you can make

By WALTER E. BURTON

A SIMPLE SETSCREW CHUCK for the headstock spindle of a lathe can be as useful as a costly three-jaw chuck. A setscrew chuck is commonly used for holding drill bits, end mills and Woodruff-keyway cutters. It can also hold workpieces, such as shafting, for turning or drilling. Setscrews bearing against the tool shank lock it in the chuck bore.

Setscrew chucks are often used in connection with a carriage-mounted milling attachment, with an angle plate or other arrangement for clamping and moving work in proper relation to drill bit, reamer, milling cutter, slitting saw, or other tool. Tools with shanks smaller than $\frac{1}{2}$ in. can be mounted in the chucks with

split bushings. The taper-shank type can be provided with two or more interchangeable heads having different hole diameters. A setscrew chuck can accommodate a conventional geared drill chuck with a $\frac{1}{4}$ -in. shank projecting an inch or two.

There are two general types of setscrew chucks. As detailed here, chuck A screws over the spindle nose, and is preferable where minimum overhang is desirable and where the tool might be subjected to considerable side pressure. Chuck B has a taper shank fitting the spindle bore and a somewhat greater overhang. It is useful where cutting pressure is mostly endwise, as in drilling.

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Carefully made and fitted, either type can run as true as the average multijaw chuck or conventional drill chuck fitted with a taper shank.

● **Screw-on setscrew chuck.** This is screwed on the threaded end of the headstock spindle until firmly seated against the spindle shoulder. Cutting its thread is tricky. To fit a 9-in. lathe spindle, the thread is 1½-8 in a 1-in.-deep hole.

A 2-in. round steel blank about 2½ in. long is clamped in a three-jaw chuck, the end faced, and a ½-in. axial hole drilled 1 in. deep. With larger drills and a boring bar the hole is enlarged as required by the spindle-nose thread—here to about 1.345 in. dia., slightly larger than the standard 1.3376-in. for this thread. The bore diameter is further enlarged to a generous 1½ in. at both ends. Length of the inner, 1½-in.-diameter bore is determined by the clearance required by the threading tool—about ⅜ in. To determine various dimensions of the threaded bore, the spindle nose and back plate of a chuck that fit the nose were used as guides.

The internal thread is cut next. Care must be taken not to jam the end of the threading tool against the bore bottom. For each cut (average depth about 0.0025 in.), the lathe is stopped a bit short of the end, and the cut finished by pulling the headstock belt by hand. A 60° point

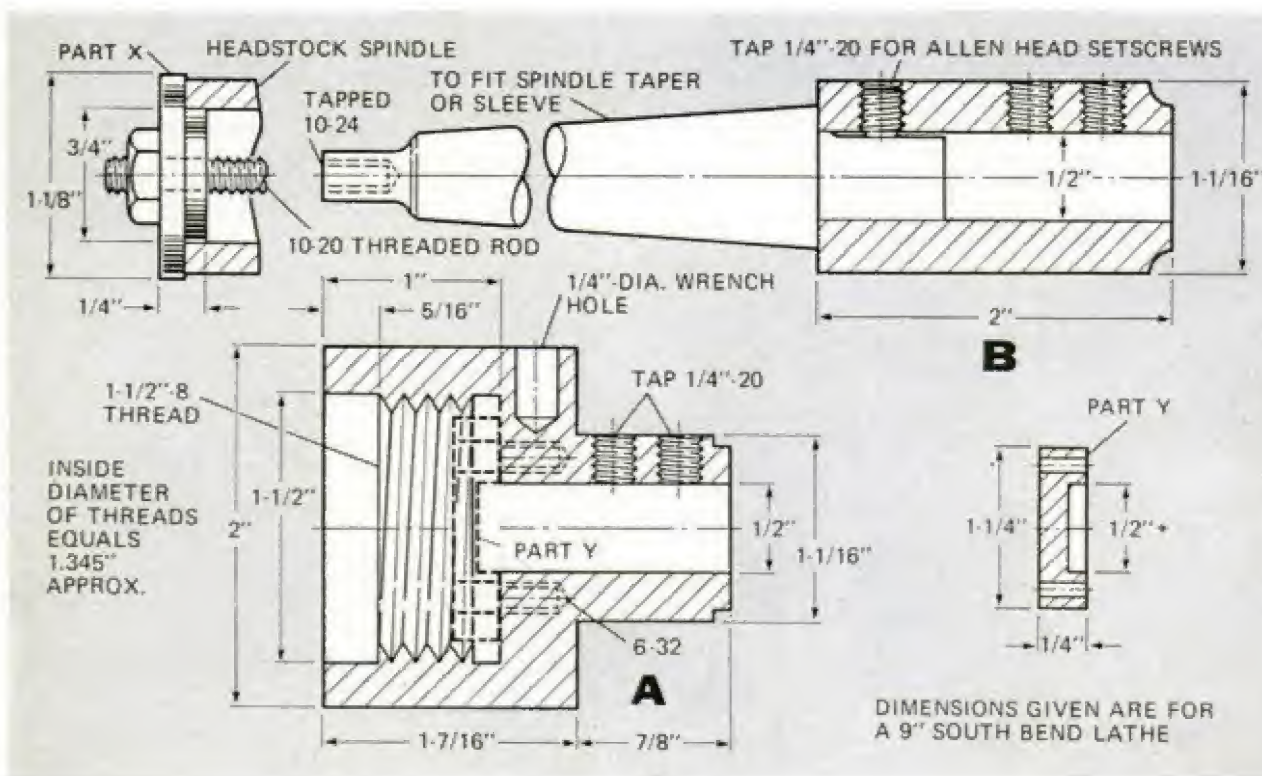
threading bit is used.

Careful measurements can produce a precise fit of threads, but a gauge threaded like the spindle nose is handy for testing the internal threads, especially when final cuts are being made. For another test remove the lathe chuck without loosening its jaws, turn it and the setscrew-chuck blank end for end, and try to screw the blank onto the spindle.

When the threading fits the spindle nose snugly, remove the workpiece from the chuck and drill a radial wrench hole (for a ¼-in. rod) as shown. This hole enables the chuck body to be loosened readily if it should stick.

The chuck blank is installed on the spindle, and the outer end machined to the form shown. Then a hole is drilled through its center, starting with a small bit, to a diameter of about ⅞ in. Because it is possible for a drill bit to produce a hole slightly out of line, a boring bar is used to bring the hole to final diameter of ½ in. This diameter depends on the tool-shank diameter and clearance necessary for easy installation or removal of the tool, and might be around 0.501 or 0.502 in. (Many cutting tools have precise ½-in. shanks.) Another way to achieve an accurate, true-running hole is by internal grinding. If such a chuck is hardened, final grinding would be done afterward.

After the outside surface has been



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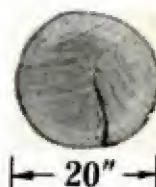


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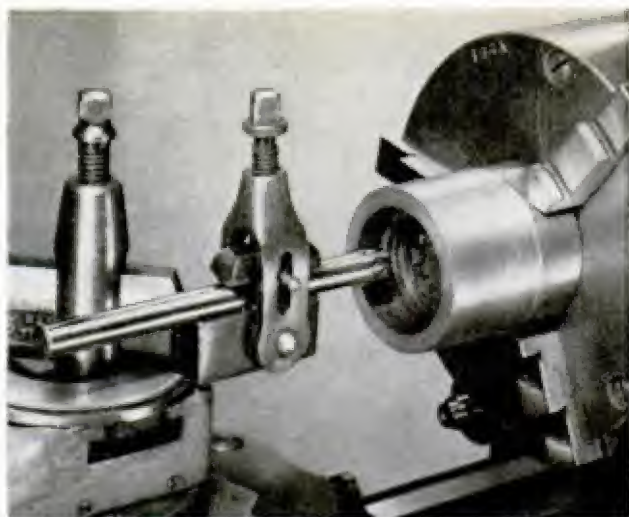
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REGULAR TWIST DRILL is used to bore a slightly undersized axial hole in body of the screw-on chuck



BORING BAR is used to finish-bore the axial hole. The hole in the side is for a chuck-removing wrench

smoothed with file and abrasive cloth, remove the chuck body from the spindle and drill and tap the two $\frac{1}{4}$ -20 setscrew holes. Make an internal back-up disc (part Y) to help the setscrews handle end thrust such as that which is produced when a large-diameter drill is driven by the chuck.

The steel disc covers the hole and has an outside diameter that fits inside the headstock-spindle hole without jamming. Two 6-32 bolts with heads filed for clearance anchor it in place. (Four would be stronger.) Disc can be removed when chucking long shanks or rods.

● **Taper-shank setscrew chuck.** This is sometimes used on drill-press spindles. The shank shown is from a broken No. 2 Morse taper twist drill. The drill is annealed and the flute section sawed off. Then the shank is installed in the lathe spindle, and punch-marked for later alignment with spindle sleeve and spindle itself.

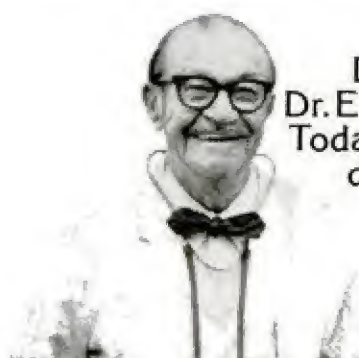
The projecting portion is machined to $\frac{1}{2}$ -in. diameter and a setscrew-flat filed on it.

The chuck body is made from $1\frac{1}{8}$ -in. steel rod. It is chucked, and an axial hole about $\frac{3}{16}$ in. in diameter bored through. The outer $\frac{3}{4}$ in. of this hole is bored so that the taper-shank end, previously machined to $\frac{1}{2}$ in., will fit snugly. Then the piece is unchucked, and a hole for the setscrew that clamps it to the shank is drilled and tapped for a $\frac{1}{4}$ -20 thread. The two parts are assembled and installed in the lathe spindle for final boring of the $\frac{1}{2}$ -in. tool-shank hole, and finishing the surface.

Because the taper shank might come loose when in use, a safety feature is added—a long, threaded rod extending from the tapered shank through a cap machined to fit the outer end of the headstock spindle. A nut tightened against this cap, part X, locks the shank in place. ★ ★ ★



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Borderless enlarging easel

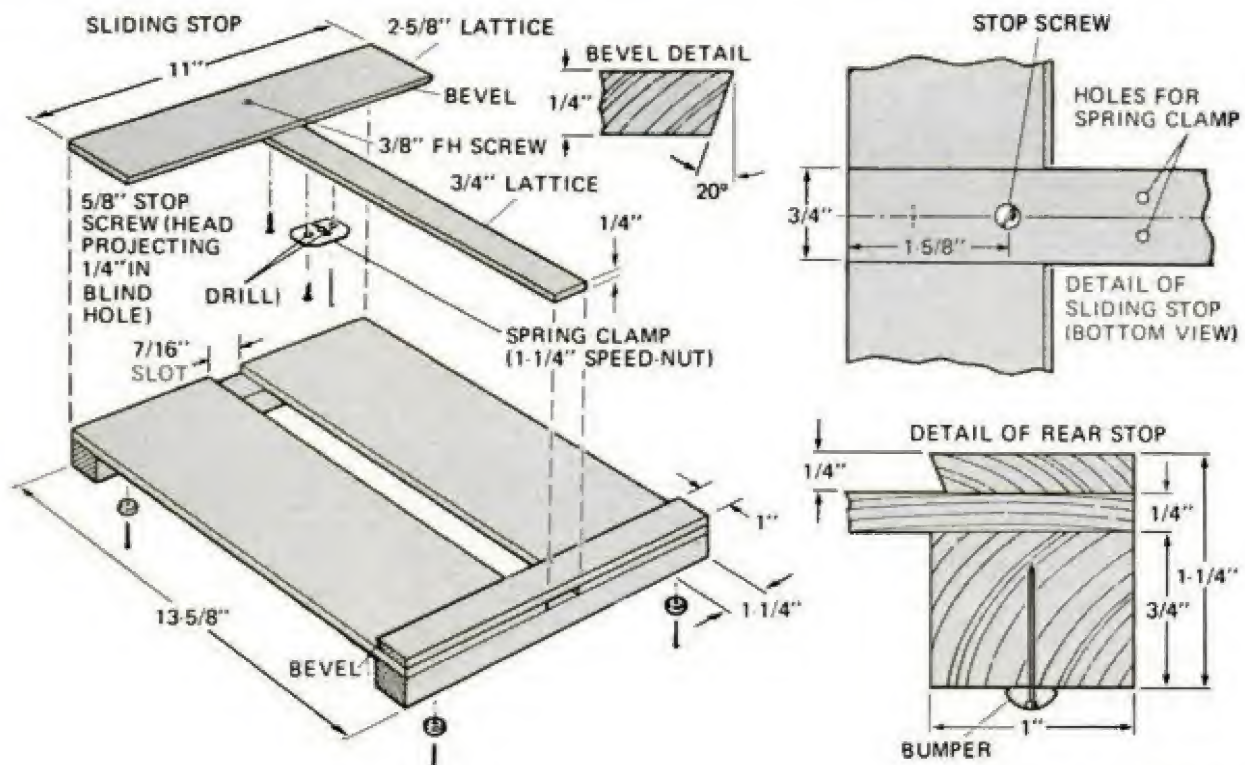
I don't like print borders. They're unsightly and they waste paper. So I made this borderless easel in one evening.

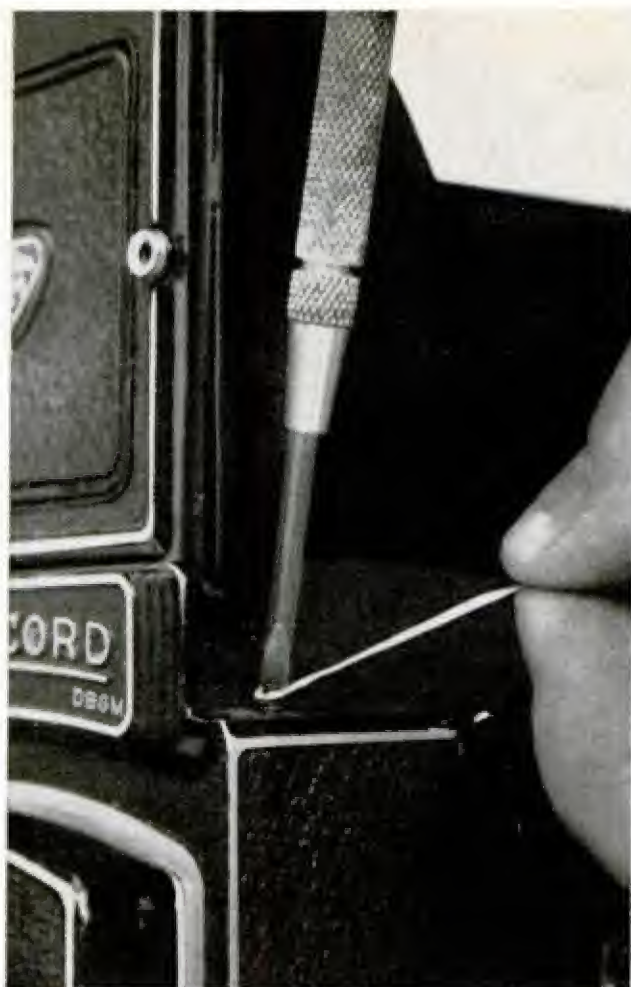
The paper's natural curl holds it in place against the overhanging bevels of the two wood stops—but the bevels are so slight that they cast no shadows on the edges of the print.

I made the easel big enough to hold an 8x10 sheet of enlarging paper in either direction, so I can make horizontal or vertical format prints without having to rotate the easel. And I put one of the beveled stops on a sliding "T-square," so it would adjust to hold any paper size.

Dimensions aren't really critical—you can use whatever scrap lumber you have around. But it's important that all pieces be properly squared, both to keep the easel level under the enlarger and to make sure the T-square will slide freely, without binding or chattering. The spring clamp mounts to the bottom of the slider, and rides under the easel platform, providing the tension needed to keep the paper's curl from lifting the sliding stop. I used a 1½-inch speed-nut, with extra holes drilled in it, but any springy metal strip will do if it's longer than the slider slot is wide.

Paint the easel flat white or yellow for easier focusing, and paint the undersides of the bevels black, to prevent reflections. —Lorne C. Bannister, Sarnia, Ont.





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"I cleared \$110 last Saturday! I'm doing wonderful. Locksmithing is a great business."
R. W. Davis, St. Louis, Mo.

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CUT ALONG DOTTED LINES



Ski care now-and later

Proper bottom maintenance puts skis in top shape and keeps them there during off-season and on

By JACK VAN VLECK

YOU CAN WHANG UP even the toughest pair of skis, no matter what they're made of and no matter what the salesman says. Even the best equipment, worn by a downhill expert or touring novice skier, is subject to scraping, crossing, bottom gouging, edge dulling and burring. If you believe the "maintenance free" stories you're going to shorten the life of your equipment. And at a price tag of \$150-plus for some of today's top-design FRP (fiberglass reinforced plastic) "schusslatzen" for instance, you'll be throwing away money if you skip the simple preventive maintenance that keeps skis going in winter and safely stored off season.

"Proper waxing tops your checklist," says Garcia Ski Corp.'s Jeff Garluck. Waxing comes after the edges have been sharpened (since filings can become embedded in paraffin) and can be done hot or cold. Satisfactory cold methods include the old rub-on stick wax technique as well as more modern paste and spray treatments. Cold waxing is easy and convenient, especially for touch-ups on the slopes, and should be done a couple times during the ski day, often matching wax type to snow conditions.

Hot wax coats, applied by iron-on or paint-on methods, last longer. An iron at medium heat is held,

(Please turn to page 50B)



TO GO AIRBORNE like ace Stein Eriksen it's necessary to start from snow level with well-maintained skis. File burrs and scratches from the edges with flat No. 10 as shown. Hold at 45° angle to bottom and use light thumb pressure

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SHARPEN SIDE EDGE with flat No. 10, removing rough spots, nicks. Result should be even edge that forms 90° angle between bottom edging surface and side



TIP EDGING of ski should not be sharp. Starting even with front end of center groove, round edging forward toward "shovel" tip to prevent tip-tripping



DEEP GOUGES require more than waxing to fill and repair. First use knife or other sharp tool to dig out any loose foreign matter before starting repair



FOR BEST BOND, a clean soldering iron is used to heat base around gouge edges. Molten repair-stick "spaghetti" is dripped in. Extinguish burning drops

SKI CARE NOW

(Continued from page 59)

point down, over ski bottoms and wax pressed against it until the wax melts and can be dribbled down one side of the ski, outside the groove, and up the other. Ribbons of wax are ironed out evenly over the entire surface—keep the iron moving so the base won't loosen its bond with the ski. Afterward you'll have to buy your wife a new iron, of course.

To paint on wax, melt it in an old pot and with a ski-width brush dip in and then press out any bubbles against the pot. Paint skis from tail to tip in 18-inch overlapping strokes. After any hot-process application, scrape the cooled coating, tip

to tail, to even the finish. A knife or coin can scrape the center groove. Use plastic or wood to clean edges.

Waxing keeps polyethylene bases from wearing down quickly, prevents oxidation, helps turning by avoiding tip-scrape. Tops of skis can use car wax to help guard against road salt when skis are carried on exterior racks. Northland's Jerry Gruggen notes that almost as much minor damage can happen while toting equipment as during actual use. Off the rack, skis should be carried bottom to bottom and strapped together to prevent edge scissoring. Transporting them inside the car is dangerous to skis and riders in case of a sudden stop. When using a public carrier,

(Please turn to page 59D)

Need More Money? Want to Be Your Own Boss?

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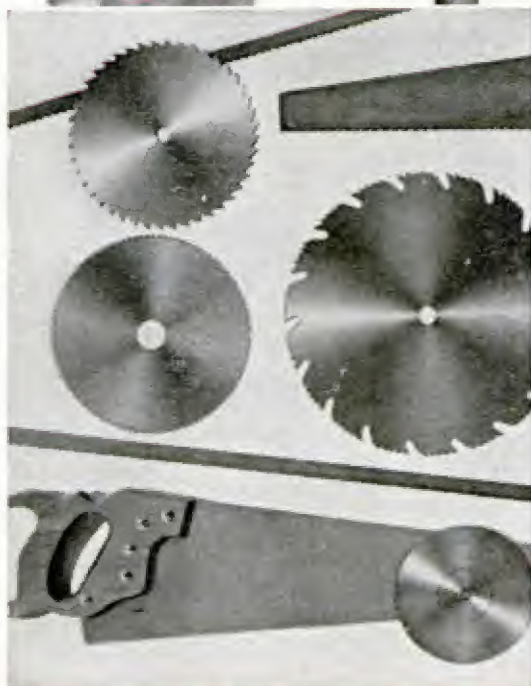
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Here's the story from Dick and Jo Ann Koester after being in business less than a year. "We have acquired another Foley Saw Filer and for the past two months we have been in full-time operation. As we live in a small town of 150 population in farm area we use our truck to pick up saws in five nearby towns. With a family to support and plans for building to our house we had to pick up a business fast and already sharpen an average of 15-20 saws a day. Business for the future looks even better as good machine filing is our best advertising."

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SHAVE OFF excess polyethylene with knife or metal scraper to bring fill down to ski level. Use repair sticks without soldering iron for field patch



IRON-ON WAX METHOD uses wax held against iron at medium setting. Drips from iron are dribbled on surfaces each side of groove, ironed out smooth



CENTER GROOVE is scraped out and smoothed with coin or knife. Wax runs in during ironing. Keep hot iron moving over bottom during smoothing of wax



PEEL WAX from edges with plastic or wood scraper to guard against scratches. Full surfaces of the ski are then leveled with metal scraper for even coat

SKI CARE NOW

(Continued from page 50B)

"Box your gear or use a ski bag," says Blizzard spokesman Frank Moran. Wrap newspapers between skis to avoid marring waxes' bases. Bagged in canvas, burlap or plastic on a roof rack, skis are protected from flying stones, ice and road salt.

Store skis vertically in wood racks at ski areas and at home so snow can drain off and no one will trip over them. When finished for a weekend—or season—wipe skis dry, wax tops and bottoms lightly and coat edges with light oil or Vaseline. Modern skis don't need to be blocked in the middle to maintain camber, but should be stored away from temperature extremes.

Strap together and suspend from cellar beams or closet hooks. Wall racks from skis stores are good. Rest ski tails on wood blocks rather than concrete floors.

Edges and bases take the worst beating. After each trip, knock off edge burrs with emery paper or a file. Run your fingernail crossways over the edges and bottom. If it sticks against an edge, you have the start of a "railing" problem—bottom wear has exposed the inside steel edge corners. To remedy this and other edge faults yourself (and save about \$4 each time), get a No. 10 flat crosscut mill bastard file. Then clamp your skis, one at a time, base up in a vise.

Lay the file flat on the base and angled

(Please turn to page 50F)



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PROFESSIONALS take waxing seriously. Here service manager prepares racing skis using special bench

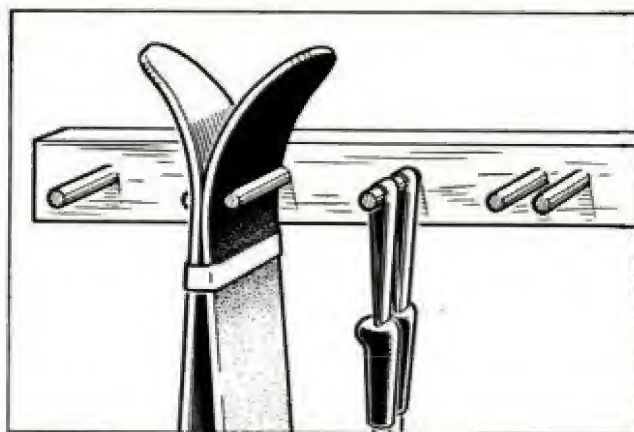
SKI CARE NOW

(Continued from page 50D)

about 45° in the direction the ski is pointing. Keep weight on your thumbs at the middle of the file and push easily in long strokes down the length of the ski. Don't shift pressure to file ends or press hard. You're working for a flat-edge surface flush with the base. If the base is worn too far, you'll have to build it up with layers of wax.

Next, clamp the ski with one edge up. File ski edge flat down the ski length to get a 90°-angle edge flat on the base and the side. At the front, from a point parallel to the groove end, bevel the edging as far as it runs up the "shovel" (tip). This keeps ski tips from grabbing.

Deep gouges and scrapes caused by "fast grass and rock garden" conditions need special attention since moisture can work into holes and start delamination. Kofix or P-Tex candles (often called spaghetti) are the answer, and come in colors to match your ski bottoms. Clean base with a rag and benzine or a brass pot cleaner (never use steel wool). Heat damaged area with a clean soldering iron. Split repair candle (for smaller drips), light and drip melted polyethylene into gouge until it's higher than base layer. Smooth cooled material with knife or gadget like Stanley



HIGH AND DRY is a good way to store skis evenings or off-season alike. Wall pegs can be made or bought. Today's skis don't need middle-block to keep camber

Pocket Surform. Very gently sand patched area with fine sandpaper, rewax as usual.

Today's fancy top ski surfaces can be scratched, "but that won't affect performance," says Ron Guisick of Hart Skis. "The melamine (finish coat) can chip but good skis have plastic or metal strips running along the outside edges to prevent excessive damage if skis cross during a run." Scratches can be sanded and waxed. Deeper cuts may mean relacquering.

Your warranty may require professional repair for major damage like delamination or edge separation. But most modern skis can last a number of season with minimum—but regular—basic maintenance. ★★

The Super Doer

The Power Gun 1000

If you're a homeowner you've got to own the new Swingline Power Gun 1000, the first extra heavy duty staple gun that does it all. It's a cinch to put up ceiling tile or cork. Power Gun 1000 drives into harder wood with less effort and greater force.

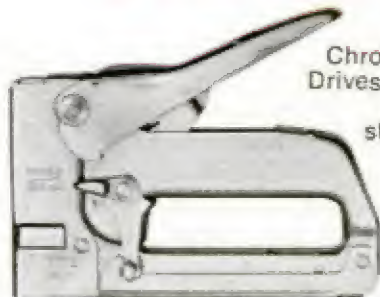
There's a Power Lever for heavy duty drive, Power Dot for Super Drive, Load-a-matic one piece loading chamber, Swing-open bottom loading, At-a-glance window to check load and a built-in staple extractor. No jam problem—easy to clear.

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Price \$13.95
Kit \$19.25



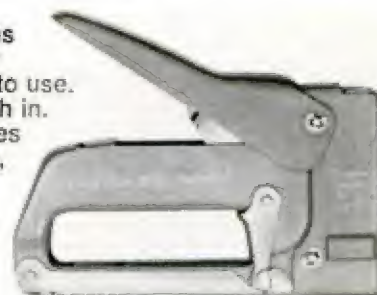
Power Gun 1000 is sold separately . . . or as a kit with three attachments—one to grip and hold wire, one to repair or make screens, one to repair or make shades. Kit comes in handsome carrying case.

2 More Super Doers!



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Camper for a compact pickup

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Yardpower roundup for '73



If you're in the market for a new mower, you won't want to miss this buyer's guide to the new mowers and tractors. A specifications chart lists models of the major manufacturers so you can compare their features and prices.

A pool for all seasons

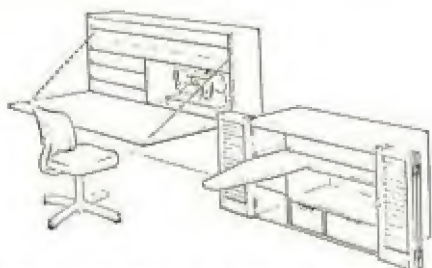


Ever dream of having an indoor swimming pool? Here's how one family enlarged the basement and made the plunge. Many grade-level basements offer the possibility of an extension that brings the pool indoors.



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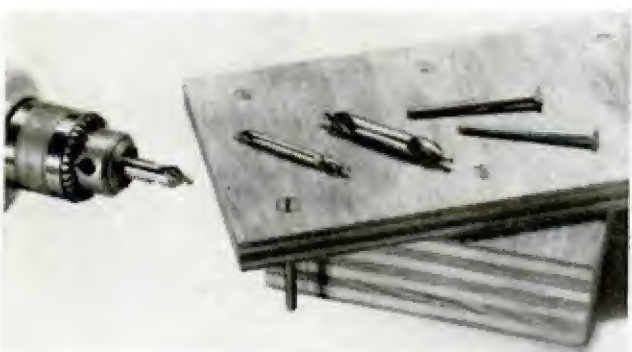
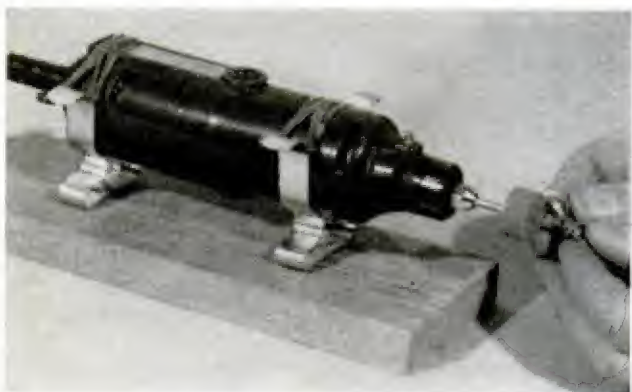
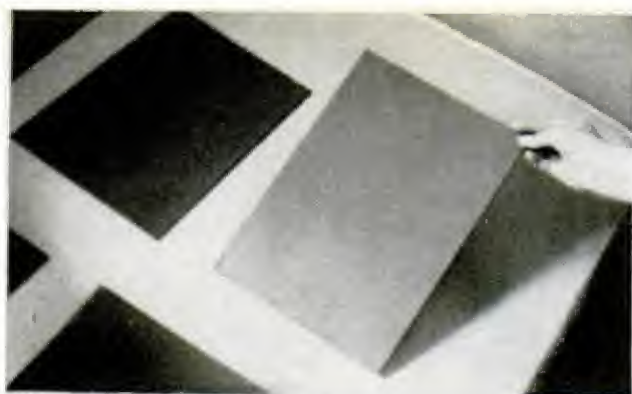
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HINTS FROM READERS

Multiple bedboard works better

If you can't sleep on the bedboard your doctor prescribed, ask him to let you try this stunt. Instead of a one-piece board, insert several plywood squares between the springs and mattress. You'll find the squares provide the necessary support, but reduce the rigidity associated with a one-piece bedboard.

—J. Ronald Mikels, Knoxville, Tenn.

Broom-clamp holder for hand grinder

A hand grinder such as the Handee or Moto tool becomes a small bench grinder when you attach a couple of spring broom clamps to a board to support it horizontally. If necessary, you can stretch rubber bands across the clamps for a better grip. The grinder also makes a great little polisher.—Ken Patterson, Regina, Sask.

Center drills serve as screw bits

In a pinch, center drills used in lathe work can serve as wood-screw pilot bits when you're countersinking holes for fh screws. Such drills come in a range of diameters that can match almost any screw-head normally used. After using a center drill, make the hole for the screw body with a twist drill of the proper size.

—Hugh Perkins, Chicago.

Sponges save the knees

One way of avoiding "housemaid's knee" when doing work that requires constant kneeling, is to wear two pieces of sponge rubber cut from kneeling pads. Simply make "garters" of elastic to fit the knees and attach the bands to the pads with rubber cement.

Another way of attaching these pads is to cut slots in the pads for the elastic.

—Bill Burd, New York.

Chicken wire holds flock of tools

If your garden tools are hard to keep handy and neatly stored, nail a length of common chicken wire to the open studs of your garage or workshop walls. The wire mesh lets you stand long-handled tools behind it; smaller tools can be hung on the wire in clear view.

—William Swallow, Brooklyn.

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IMPORTS AND MOTORSPORTS

BY BILL HARTFORD



FIRST AMERICAN-MADE CAR to win an event in the International Rally Championship of Makes series is . . . a white whale! Competing against the likes of Datsun 240Zs, Saabs and other experienced rally cars and teams, the Jeep Wagoneer, tagged "Moby Dick I," pressed on to take the Press On Regardless Rally in northern Michigan. The gruelling 2000-mile endurance challenge was on the international calendar for the first time. Gene Henderson and Ken Pogue teamed the winner for Henderson Competition Ltd. A second Jeep, Moby Dick II, naturally, was third with Erhard Dahm driving, Jim Callon navigating

GENTLEMEN, START YOUR ENGINES! You kids and moms, too! Even if you've never jumped on a kick starter before, you can learn how to ride a motorcycle simply and safely—and it's free. Yamaha has started a Learn-to-Ride program that will be coming to over 60 cities this year. They provide the bikes, the helmets and the instructors. All you do is write to Yamaha's Learn-to-Ride Program, 3425 Wilshire Blvd., Suite 700, Los Angeles, Calif. 90010, to find out when Yamaha will have its machines in a park or stadium near you.

IT'S A HAPPY BIRTHDAY YEAR for NASCAR, the National Assn. for Stock Car Auto Racing, and the 25 candles should be stuck in the sand at Daytona Beach. That's where the racing started, believe it or not, on a course laid out on the hard-packed sand. Not far from the beach is the huge Daytona International Speedway where special events and a festive air will compete with the roar of the traditional February Speed Weeks right up to the Daytona 500 on Feb. 18.

MAZDA SWEEP NEARLY COMPLETE. The rising sun has reached Sunrise Hwy. and the only rotary-engined cars available in the United States are now in almost every state. Driving the RX-2 and RX-3 models is an extraordinary experience that sums up: little engines, big performance! (Want to see my speeding ticket?) There's a 24/24 warranty on the Wankel engines and a new automatic transmission for '73. Mazda has been coming on strong since 1961 when it became the



MAZDA RX500: Test bed for engineering and styling and a teaser for Wankel and sports-car enthusiasts

first auto company to sign a licensing agreement to use the Felix Wankel invention. And we hope it won't be long before there's a Mazda with looks to match its performance—especially if it happens to be a production car based on the ex-

(Please turn to page 54)

ANOTHER TEASER: German Hercules motorcycle has Fichtel & Sachs single-rotor, air-cooled Wankel, but it isn't being imported to the United States as yet





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IMPORTS AND MOTORSPORTS

(Continued from page 52)

perimental, mid-engine RX500 shown on page 52.

THE SMALL CAR is the car of the future; just ask anyone at Fiat. The company put Italy on four wheels with its pre- and post-war mini-cars: They were a step up from the family



BIGGER THAN A BREADBOX but hardly bigger than the Fiat 600 it replaces, the 126 is to be, according to Fiat chief, Giovanni Agnelli, the bread and butter car for the Italian market for next 10 years

motorcycle. The new 126 (two-cylinders, 23 hp, top speed about 65 mph, \$1400) should be perfect for straddling a couple of square meters of sidewalk to park in congested Italian cities. Sorry, Manhattanites, but the 128 is the smallest Fiat you can buy here.

MADE IN THE USA in 1906, the only remaining "American Mercedes" is back in the United States. The car came off the assembly line in Long Island City, at the Steinway factory. The piano manufacturer, William Steinway, was enthused about Gottlieb Daimler's early motor cars and arranged to assemble them here from parts made in Germany. This 1906 model was in the Daimler-Benz museum in Stuttgart until it was brought back for display in the lobby of the new Mercedes-Benz of North America headquarters in Montvale, N.J. You can see it there. ★★



HANDLE WITH CARE: It's last known Mercedes-Benz model that was built in... Long Island City, N.Y.?

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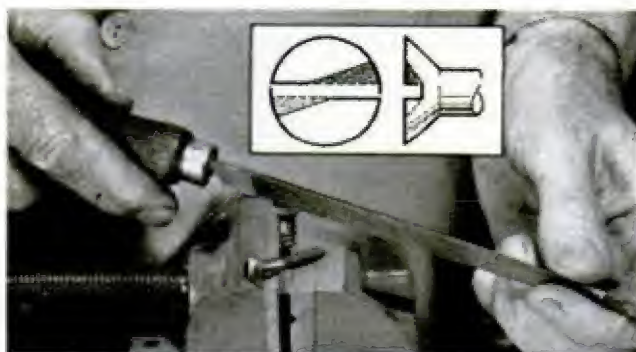
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HINTS FROM READERS

Reverse filing prevents clogging

When filing aluminum or other material that tends to load file teeth, frequent reverse filing—pulling the file against the work instead of pushing—may keep the teeth clean without the use of a file card. Most ordinary files will cut aluminum to some extent on the reverse stroke, smoothly and quickly, without clogging the teeth.

—Joseph Winn, Richmond, Va.

First aid for Venetian blind

When a Venetian-blind slat drops because of a broken cross member in the tape, it can be supported temporarily by a cord looped around it and the slat above it. If long enough, a rubber band can be used instead of string. Such a repair makes the blind normally usable until the tape can be replaced or repaired.

—Phillip Maynard, Miami

One-way wood screws

By filing a bevel on the upper half of the slot in a flathead wood screw and then rotating the screw a half turn and filing away an equal amount on the lower half, you can increase the security of locks, hasps and hinges. Such altered screws can be driven with a regular screwdriver but they cannot be backed out with one.

—Dan D. Powell, Des Moines, Iowa.

Dustless rust removal

One whiff of rust dust can irritate the respiratory tract of some persons for days. If you are troubled this way, remember this stunt. Before sanding, scraping or wire-brushing a rusty surface, wet it with shellac thinner (alcohol) and the rust will not turn to dust. The alcohol will soon evaporate and not interfere with later finishing.—Ted Behr, Utica, N.Y.

Cardboard 'blocks' cushion machine

I found that by gluing together several thicknesses of ordinary corrugated cardboard to form blocks about 1½ in. thick and placing them under a small air compressor, the vibration is lessened considerably. If you glue every other piece at a right angle, you'll be surprised what a solid block results and the cushion value it has.—Warren Pease, Parkersburg, W. Va.

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THE BICYCLE SHOP

By EUGENE A. SLOANE

This month Gene catches up on some of the many cards and letters from readers and answers their questions about bike repairs, tools and touring

Q. My new Chiorda bike started out with both wheels wobbling and rubbing against the brake shoes. What can I do?—Doug Stewart, Greenwich, Conn.

A. Wheels need alignment or brake caliper arms need repositioning. First make sure wheels are in line. If not, tune up by tightening spokes on the side away from where rim is too far to one side. That is, if the rim is too far to the left, tighten a spoke or two on the right side. You may have to loosen a spoke or two on left side. Ditto on a wheel rim too far to the right, but reverse spoke adjustment sequence. If the rim still rubs on brake shoes, loosen the brake-bolt nut where the brake is fastened to the fork or rear chain stays and reposition the brakes. Brake caliper arms may need repositioning, which can be done by giving the brake cable about 1/4-inch slack to permit brake shoes to be held further away from the rim.

Q. A bike I want to buy has had all emblems and decals removed for cosmetic reasons, and it was given to the current owner. It has Campagnolo components and Weinmann 999 brakes. How can I tell if it has Reynolds 531 or Columbus tubing?—The frame is chrome-plated.—Mark Trombino, Staten Island, N.Y.

A. I would guess this is a Schwinn Paramount, since few others chrome a frame. Take it to a Schwinn dealer for a check. It's almost impossible to test, short of a metallurgical check, whether it's a Reynolds or Columbus frame metal. Thin seat and chain stays and forged-steel dropouts would be additional clues. If the bike weighs no more than 23 pounds, this would indicate Reynolds or Columbus tubing.

Q. My rear-derailleur cable keeps coming out of the rear derailleur. Tightening the cable retain-



RECENTLY INTRODUCED in a new line of John Deere bicycles was this 27-inch, five-speed two-wheeler that features a unique frame style which is popular in Europe. Center-pull hand brakes are mounted on the handlebars and the speed shift is located on the handlebar stem. John Deere, long known as a farm-equipment manufacturer, entered the recreation field with snowmobiles in 1971. Now, it's bicycles

ing nut doesn't seem to help.—Paul Thomas, Midvale, Utah.

A. You may have stripped the cable retaining nut on the derailleur. Or, if the cable does not come out of the derailleur but simply goes slack when you shift to the high-speed gear, the derailleur body parts may be dirty and need cleaning and relube with light oil. Or the derailleur spring may be weak or broken so that the derailleur body won't shift down. Check all these points. Push the derailleur in and out, sideways. If it's slack, you may need a new derailleur spring. If it sticks, cleaning may be the answer.

Q. This isn't a question, but a tip. Loctite's Lock n' Seal keeps derailleur adjusting nuts, pannier carrier nuts and bolts and other nuts on a bike from coming loose, yet a wrench will break the seal.—Lisbeth Simpson, Warwick, R.I.

A. Thanks. If you can't find Loctite products in a hardware store, the firm is located at 705 Mountain Rd., Newington, Conn. 06111.

Q. My plastic saddle is very painful. Shaving it thinner from underneath helps some, but I may try drilling holes in it. Instructions with Simplex Criterium derailleurs say not to touch tension springs. So when renewing the derailleur I pulled off the spring plate, releasing the spring. Attempts to replace the spring ruined the spring hole in the plastic housing. To save the derailleur, I filed out the plastic tip and filed an alumi-

(Please turn to page 64)

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THE BICYCLE SHOP

(Continued from page 62)

num D-shaped washer to replace it. It works well and tension is okay.—Mike Redfern, Niagara Falls, N.Y.

A. There's no way you can break in a plastic saddle. You might try covering it with leather, but it's still going to be hard underneath. Some Japanese plastic saddles have a foam cover topped with vinyl plastic covers, but can't be shaped to one's configuration. Regarding ruining a Simplex derailleur plastic housing spring hole, join the club. I've done it myself. Your solution is excellent!

Q. Where can I get an exploded view of a Huret-Allvit derailleur?—Alan George, Amherst, Mass.

A. Ask your bike dealer to order one from his wholesaler. Schwinn uses a similar derailleur, so a local Schwinn dealer may let you look at his shop manual.

Q. I just bought a 10-speed. In testing it, I noticed the chain skips every now and then on some gears. I tried adjusting the shift levers, and the chain tension spring on the derailleur is into the tightest slot.—Martin Otterson, Sayward, B.C.

A. You didn't state whether this is a new or used bike. If used, the problem could be worn gears. Check to see if gears have wear on inside of teeth, causing a "lip" which lifts the chain off and throws it on another gear. If new, check the shift-lever handle locknut. The shift lever should move stiffly; otherwise the derailleur tends to shift by itself. Or the chain could be too long. When the chain is on large front and rear gears, the rear derailleur pulleys should be flattened and parallel with the chain. If not, squeeze the chain until the derailleur is so aligned, remove the two or three links as needed, with a chain rivet remover which you can buy from a good bike store for about \$2.50.

Q. To your knowledge, has anyone ever tried to operate both front and rear (caliper) brakes with a single lever? Seems to me this would be simpler and safer.—Ken Greenberg, Chicago.

A. No, not that I know of, so far as conventional mechanical caliper brakes are concerned. The problem is that you need to be able to be selective, in that back brakes should be applied slightly ahead of front brakes.

And in going downhill at high speed, you should apply first the rear and then the front brakes alternatively to keep from overheating the rims. Shimano (Shimano American Corp., 1133 Avenue of the Americas, New York, N.Y. 10036) makes a really good hydraulic caliper bike brake which one lever operates. It's separately ported so the back brake is actuated a second before the front brake, and each brake has its own cylinder. These are really fantastic brakes; they even work well in wet weather. They aren't in use on American bikes, which is too bad because my tests show these hydraulic brakes to be superior even to \$75 Campagnolo brakes; they cost about \$20 less.

Q. How do I remove a gear cluster so I can put on wider range gears? With a hammer and brass punch?—Cornille Vanosch, New Bedford, Mass.

A. Whoa, hold it! Don't use a hammer and anything else on any bike part! You need a freewheel remover. Trouble is there are many freewheel makes, each needing a special tool, with some overlap. Look at your freewheel; is it Atom . . . Regina . . . Shimano? Whatever the name, tell your bike dealer, who should have the right tool in stock or order one. To use it, remove the quick-release skewer, insert the tool, replace the skewer and turn the removing tool counterclockwise to remove the freewheel. On some slotted designs, such as Shimano, you won't need to reinstall the skewer to remove the freewheel. The tool costs about \$2.

Q. I have never been able to align the derailleur with my inside chain ring. Can I move the chain ring in or out without buying a new axle?—George Heskey, Newtonville, Mass.

A. I assume you mean the front derailleur. If so, it should have plenty of adjustment so you can center the derailleur chain guide over the inner chain ring (the small one). Some front-derailleur chain guides are also adjustable on the chain-guide shaft. If not, try the Campagnolo Record front derailleur, which should work. If the rear derailleur is the problem, just add or remove thin washers from between the axle cone locknut and axle cone nut to align transmission. Correct alignment is when the third gear of the rear five-gear cluster is lined up between the two front chainwheels. ★ ★ ★

GOT A PROBLEM WITH YOUR BIKE? Ask Gene about it. Send your question to Bicycle Shop, *Popular Mechanics*, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of general interest will be published in this column.

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'73 Apache Ramada, \$1995*

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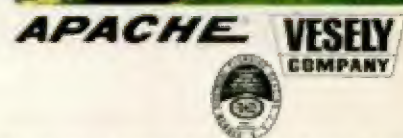
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*Higher in Canada. Does not include freight charges. Wheel covers and window awnings shown are extra cost.

HOMEOWNERS' CLINIC

BY W. CLYDE LAMMEY

Why more moisture?

I've installed electric forced-air heat, replacing an oil-fired furnace. Now the windows sweat and occasionally in cold weather there is moisture on the walls near the ceiling. I've never had this problem before. Why now?—Ed Tripps, Buffalo.

You're no longer heating with a natural flame, which normally exhausts some of the warm, moist air through the chimney flue and also pulls in colder, dryer air from outside through opened doors, tiny openings around window frames and the fireplace flue. Your electric furnace is unvented and the only heat source is the heated elements at times when the unit is cycling. This accounts for the rise in moisture content of room air. If you use a humidifier, you may find you no longer need it, except possibly in extremely cold weather.

Flattening warped plywood

A choice piece of plywood got wet in my flooded basement. The plys did not separate, but the piece warped. Is there some way to flatten the panel?—R.J. Kinsman, Lancaster, Pa.

Place the panel on a level floor, table or bench, then clamp or weight the piece sufficiently to flatten it. Dampen the top face uniformly and allow it to dry. Your chances are fairly good that the panel will remain flat after drying.

Toilet tank leaks

Recently my plumber installed a new ball cock and float in my toilet tank. This worked for a time but now water in the tank rises above the overflow, resulting in a constant leak into the bowl. The float is nearly submerged before the thing shuts off. Can I correct this trouble myself?—Manly Benson, Des Moines, Iowa.

Hold the float arm in closed position and unscrew the float. There may be water in it. If not, turn it back on the rod tightly. Then bend the rod down slightly and flush to check. If water still rises above the

water-level mark, bend the rod a little more. This usually solves the problem, but not always.

At the end of the pivoted arm that actuates the ball valve you'll see an adjusting screw. Turn this down a turn or two and flush to check. If not sufficient, turn the screw down until the valve shuts off completely at, or slightly below, the water-level mark.

Replacing bulb in lighted globe

I have a lighted world globe on a pedestal and recently the bulb burned out. Close examination reveals no way to remove the globe from the stand or to reach the socket to replace the dead bulb. Can you enlighten me?—George Meade, Los Angeles.

Originally, the switch, socket and bulb were installed inside the globe, so there must be a way to remove the fixture. Incidentally, remember these globes are usually of glass so proceed with care! Usually there's a pivot screw at the top—turning this out will release the globe from its peripheral support. At the bottom of the globe you'll likely find a removable flanged disc to which the socket and switch are attached. Remove this disc, replace the bulb and remount the parts in the reverse order.

Work carefully to avoid damaging the gasket between disc and bottom of the globe. When replacing the fixture, be sure to put the gasket back in the same position that you found it.

Paint peels from plaster patch

A roof leak has led to a plaster patch on a bedroom ceiling. I painted this patch with the same paint that was used originally on the ceiling. Now the paint is peeling. How can I solve this problem?—J.E. Snelling, Denver.

I'm afraid you didn't wait long enough for the plaster to dry thoroughly. This takes time, as much as two months or more, depending on local conditions. Scrape and sand off all the loose paint, wait another month or so, then apply an undercoater or shellac, and repaint. You'll likely have no further trouble. ★★

Do you have a home maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems of wide interest will be discussed in this column.

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Filter Kings, 17 mg. "tar," 1.3 mg. nicotine; Longs, 19 mg. "tar," 1.5 mg. nicotine, av. per cigarette, FTC Report August '72

FEBRUARY 1973

Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.



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SOLUTIONS FOR MECHANICAL HEADACHES

AUTOMOBILE CLINIC

BY MORT SCHULTZ

Well water

Water accumulates in the well of the tailgate of my 1971 Oldsmobile Custom Cruiser when it rains. Can you suggest a way of getting it to drain?—Jay W. Miller, Largo, Fla.

There's a drain hole in the bottom of the tailgate on the right-hand side. Dirt and mud have apparently clogged it, allowing water to back up. To clean out the drain, you must remove the back body lower housing access hole covers, and lower housing drain sealing strip.

Changing vinyl top color

Is there a paint I can use to change the color of a vinyl top?—Ralph Wethli, Hollywood, Fla.

There are probably other paint companies that make such kits, but the one I'm familiar with is the VR-1 system distributed by Young Paint and Varnish Co., 1 South Ave., Fanwood, N.J. 07023. It contains a conditioner (cleaner), paint and luster finish. The paint should be sprayed on with professional-type paint spray equipment. Price of the kit is \$13.25.

Water injection

I have a 1965 Chevrolet Impala with a hangover brought about by water in its gasoline. I have changed the carburetor and flushed out the fuel tank. The car has a new gas cap. The problem continues. Help.—J. W. Rezendes, Union City, Calif.

If you've been buying gasoline from one service station, switch on the remote possibility that it's responsible for pumping water into your car. After again flushing out the gas tank to assure that no water remains, fill the tank to the very top with gas and check carefully from gas cap to carburetor for a fuel leak. Pay particular attention to the filler pipe. If gas is leaking from a spot, water could be leaking in through the same spot. Finally, don't overlook the likelihood of condensation, especially if you're in the habit of keeping the fuel level low. Keep the tank topped off.

Tuning in

The AM-FM radio in my Mercedes-Benz needs a new transformer that no one I have contacted here can supply. You're my last hope.—Carl N. Gotch, Phoenix.

Apparently, you've done some troubleshooting and don't have to pack up the whole radio to send it back to the manufacturer, who I would guess is Becker. The majority of radios in late model Mercedes have been supplied by Becker Auto Radio—USA, 613-19 South 24th St., Philadelphia, Pa. 19146.

To stop a leak

There is an oil leak from the rear of the intake manifold of my Ford's 352-cu.-in. V8 engine. My mechanic has replaced the gasket twice, but the repairs last only for six months. Has a service bulletin been issued concerning this?—Stanley Green, Union, N.J.

Not that I know of, but let me give you a few things to think about. When a new gasket is installed, both the block and intake manifold surfaces must be perfectly clean. The mechanic should use a high-grade sealer, such as Permatex No. 2, on both surfaces. During the installation, the gasket must not shift even slightly. If it does, it may pinch and lead to leakage. Finally, it may prove beneficial to retorque the intake manifold attaching bolts periodically.

Hot foot for a cold carb

My problem is carburetor icing with a 1969 Datsun 1600-cc sedan. When the engine quits on a cold morning, you can actually see ice inside of the carburetor. What should I do about this?—L. Sargent, Belfair, Wash.

If you have a Datsun dealer in or near Belfair, ask him to install the carburetor de-icer kit issued by the company to correct this problem. If you don't, turn the carburetor air breather around toward the firewall. This will permit some hot

(Please turn to page 70)

AUTOMOBILE CLINIC

(Continued from page 69)

air to get inside the carburetor to help control the icing.

Grounding out

My 1971 Pontiac 350-cu.-in. engine has an electrical problem. The headlights dim badly and flutter as I slow the car down. When it is brought to a complete stop, the lights get brighter. The same thing happens to the directional signals when they are operating. The faster I stop, the worse the condition. The alternator, battery and voltage regular are top draw. Any suggestions?—Phil Phillips, Fort Worth, Tex.

Four conditions commonly cause this problem. You have eliminated three; now check into the fourth—a loose ground.

Oil burner

Have you determined why the Ford Pinto with 2000-cc engine is an oil user? Ours guzzles a quart every 600 miles.—Gordon W. Battey, Fort Worth, Tex.

So do others, but a Ford service bulletin, No. 22 (8/4/72), has been issued to stop this. It provides for the installation of a new type of valve stem seal.

Chatterbox

The posi-traction rear end of my 1972 Chevrolet ½-ton pickup truck has had the clutch plates replaced twice within 12,000 miles because of chatter. Is there something I can do to prevent a recurrence of the problem?—Paul Shampine, San Antonio, Tex.

It's not your problem alone, Paul. Other owners of Chevrolet passenger cars and trucks with posi-traction rear ends have been experiencing the same condition. Clutch plates aren't meshing properly. However, there could be a simple solution. If the chatter begins again, immediately drain the fluid and refill the rear end with fresh posi-traction lubricant, but this time add a can of GM Posi-Traction Rear End Additive (part No. 1050428).

Exhausting problems

Over the years you have helped me solve

many problems through Automobile Clinic, and I am grateful. Now I would like to return the favor by passing along information concerning a difficult-to-diagnose problem I had with a 1971 Buick, 400-cu.-in. engine. This engine, in warranty, developed a high-pitched whistle which made us think it had a vacuum leak. It lost power at about 50 mph. The dealer kept the car about two weeks and finally in desperation cut out a section of the exhaust pipe leading from the left bank to the right bank ahead of the muffler. This section of pipe was laminated and the inside had collapsed, almost closing off the passage. What do you think?—W. E. Garrison, Aiken, S.C.

This is good information for Buick owners to stick in their bonnets. Thanks.

Service tips

● **Volkswagen** is one manufacturer that has spelled out its position on additives. They tell owners, "No additives of any kind should be mixed with the fuel, the lubricating oils or fluids. Buy a name-brand oil labeled 'For Service SD (or MS).'"

● **Plymouth** wants to clear up the confusion concerning use of the manual choke in the 1971-72 Cricket. Pull the choke control out all the way and turn the knob clockwise to lock it in position. It is not necessary to place your foot on the accelerator pedal. Start the engine and let it idle for about 15 seconds. Unlock and push the choke in three-quarters of the way. Drive the car until proper engine heat has been reached. Then deactivate the choke completely.

● **Chevrolet** says that the clear translucent spots on windshields and windows of some new models are probably not imperfections, but may have been caused by the spilling of primer which is used in production to obtain adhesion between the glass and caulking compounds. If it is this, the "stain" can be removed by rubbing it with a pencil eraser or by carefully scraping the spot with a razor blade.

● **1971 Comet** engines with the 200-cu.-in. engine and an automatic transmission may be stumbling and hesitating despite tune-ups. If yours is, replace the accelerator pump cover assembly with a new one. It's part No. D1DZ-9528-A. ★★

GOT A PROBLEM WITH YOUR CAR? Ask Mort about it. Send your question to Auto Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of general interest will be published in the column.

"Yeah, but station wagons are so dull."

That's what people used to say.

But now there's the Hornet Sportabout, the anything but dull Sportwagon from American Motors.

It's just the right size outside and inside there's plenty of cargo space.

And it has four doors and a standard six cylinder engine that leaves other little wagons behind.

Sportabout is easy to handle, easy on gas, easy on your pocketbook and very easy to fall in love with.

And only American Motors makes this promise: The Buyer Protection Plan backs every '73 car we build, and we'll see that our dealers back that promise.



Buckle up for safety.

AMERICAN MOTORS BUYER PROTECTION PLAN

1. A simple, strong guarantee, just 101 words!

When you buy a new 1973 car from an American Motors dealer, American Motors Corporation guarantees to you that, except for tires, it will pay for the repair or replacement of any part it supplies that is defective in material or workmanship. This guarantee is good for 12 months from the date the car is first used or 12,000 miles, whichever comes first. All we require is that the car be properly maintained and cared for under normal use and service in the fifty United States or Canada, and that guaranteed repairs or replacement be made by an American Motors dealer.

2. A free loaner car from almost every one of our dealers if guaranteed repairs take overnight.

3. Special Trip Interruption Protection.

4. And a toll free hot line to AMC Headquarters.

AMC  **Hornet**

We back them better because we build them better.

Introducing the Hornet Hatchback.

A sports car with room to travel in.

Isn't that a nice idea? A car that does everything a sports car should do.

It moves like one. It handles like one. But it doesn't cost like one.

And the Hornet Hatchback gives you

lots of extra room when you need it.

Just fold down the back seats and load up through the hatch.

And only American Motors makes this promise: The Buyer Protection Plan backs every '73 car we build, and we'll see that our dealers back that promise.



Buckle up for safety.

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2. A free loaner car from almost every one of our dealers if guaranteed repairs take overnight.

3. Special Trip Interruption Protection.

4. And a toll free hot line to AMC Headquarters.

AMC  **Hornet**

We back them better because we build them better.

Good art at a price you can afford

We tell you where to get low-cost prints, how to mat them and how to make 27 different frames from standard wood moldings.

By **HARRY WICKS**
Workshop Editor

Photos by Robert D. Borst
Stylings by the author



THE HANDSOME FRAME for *Christina's World* by Andrew Wyeth on the cover of this issue closely duplicates the original which hangs in New York's Museum of Modern Art.

A professional framing shop would charge about \$75 for such a frame; our actual cost to make and finish it in the *PM* shop was \$16.83. A reproduction of the painting is available from the Museum of Modern Art for \$8.

Similarly, the frame for Wyeth's *Northern Point* (above) was created using a spinoff design of the first frame. This one cost about \$16 to make. The print is available for \$16.

All 27 frames shown in this issue in color (cover and pages 73, 74, 75 and 76) were created in the *PM* shop. We have

made framing easier by using a basic two-part assembly: surfaced-four-sides (S4S) lumber for a subframe and standard pine moldings for the decorative front frame. Happily, these moldings are available at low cost at all lumberyards.

How the frames were made, plus other picture-frame know-how, is detailed in text and illustrations that follow. The concluding section of the article tells how each was finished.

If you are interested in any of the reproductions that we have framed, you'll be happy to know that they are available by mail. Sources are listed on page 190.

Tools and materials. Because construction techniques have been kept simple, the frames can be made using hand tools only. If you own power tools, the job will go



Ballet Girls/Duteurte



Gone for the Summer/Hamilton



Amber Field/Russell



Tiger with Red Background/Hug



Island Silhouette/Ross



Passenger/Martin

ALL FRAMES were created using moldings for front frames, surfaced-four-sides (S4S) lumber for the sub-frames. Each of the 12 moldings at left was used on at least one of the frames in this story. From top: cove (2¼ in.), glass bead, backband, clamshell stop, mullion casing, quarter-round, corner guard, picture mold, clamshell base, dripcap, solid cove and a 3¼-in. crown/bed molding. Using instructions given in text, you can duplicate or create your own.





Still Life with Pitcher/Chailloux



Ship in Drydock/Listri



Still Life/Salinas



World War II Tank Print



Pirate Treasure Map



Nature Morte Avec Three Fruits/Genis



Buddha/Lee



Courtyard/Felmar



Sailboats/Bria

PRINTS AND REPRODUCTIONS selected for use in story are all available by mail order. Five pieces of art, such as lithograph directly above, are original works. Complete details for making and finishing frames (and where you can buy prints) are given in text and how-to section.

MORE →



MAKING YOUR OWN FRAMES is just half the fun; creating attractive wall groupings is another reward. Above: old-time posters, woodcut and tools (from

author's collection) on burlap. Below: a Charlie Chaplin and three other posters. Most are available at bookstores; they can also be mail-ordered



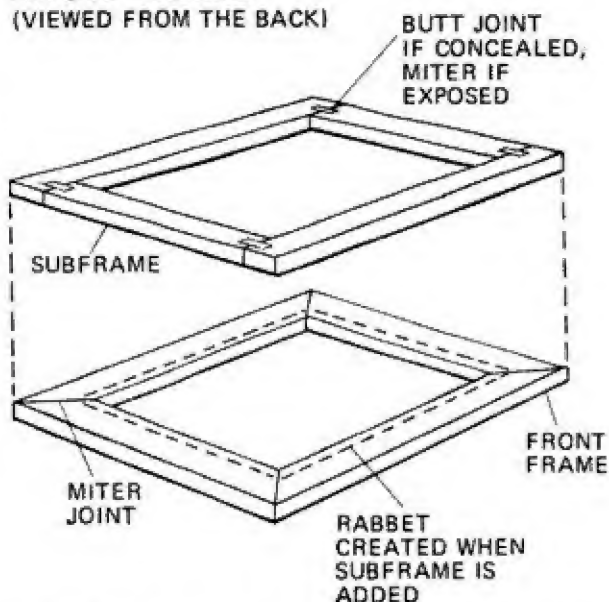
faster, but the techniques remain unchanged.

Selecting stock. Standard pine moldings are the key to creating a good-looking frame; this factory-shaped stock eliminates the need for a router or shaper, or having to pay to have this work done by a cabinet shop. If possible, when you buy your moldings, pick out the materials yourself. Or at the least, take a sighting along each length of molding to assure its being straight and free of twists and bows. If you don't, you will quickly learn that warped moldings will give you trouble when you attempt to close a mitered joint. Also, avoid moldings that are excessively sappy; these will not take stain evenly, and you'll be disappointed with the finished product no matter how fine your carpentry.

Selecting the right frame for the picture. Since styles and tastes are constantly changing, you do have considerable "artistic license" when it comes to creating a frame. The basic rule to keep in mind is that the frame should complement the picture it will contain. Thus, a wide frame utilizing bold moldings is best suited to heavy, bold prints and oil paintings; narrow, simple frames should be used on small, delicate pictures.

BASIC FRAME

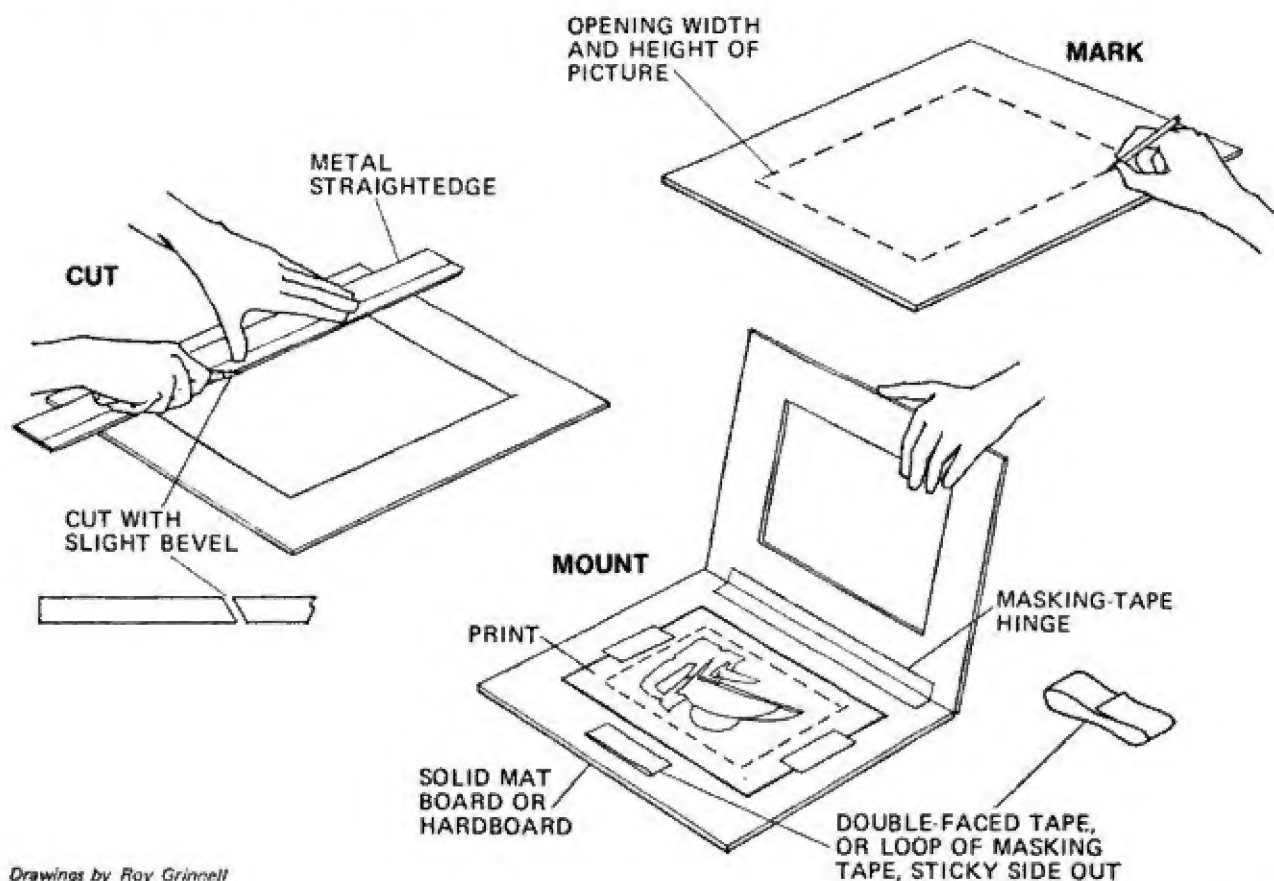
(VIEWED FROM THE BACK)



BUTT JOINTS are used on subframe, mitered corners on moldings. Rabbit is formed when these are joined

To focus attention on a decorative object or display, such as the antique tools (opposite), use either an appropriately textured backing or make a frame with a shadow-box effect (that is, with the front frame protruding an inch or so from the framed objects). A decorator rule-of-
(Please turn to page 178)

HOW TO MAT PICTURES



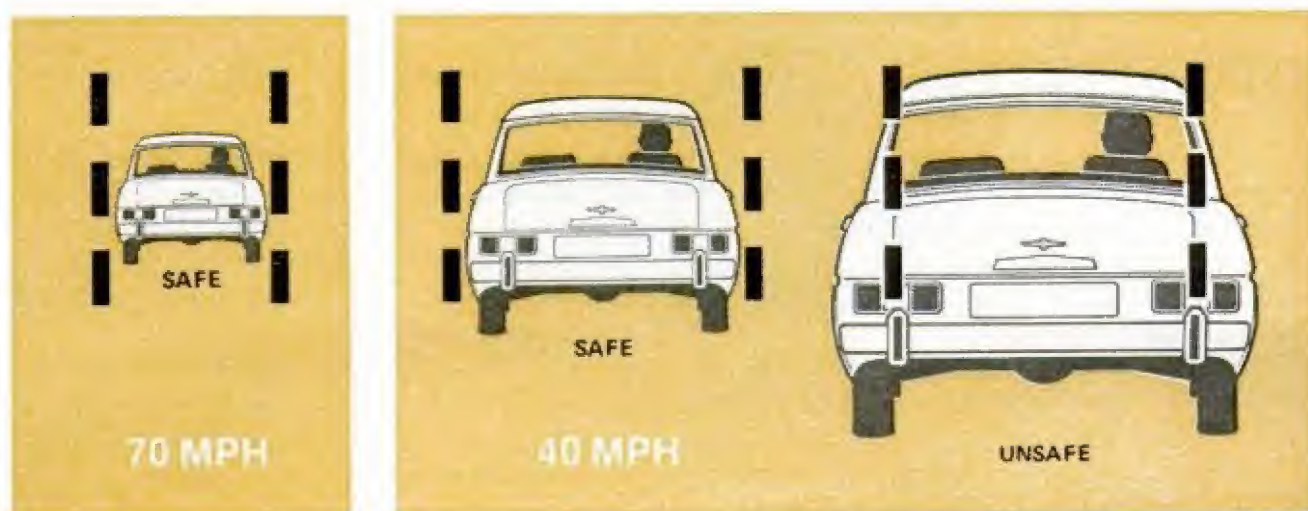
Drawings by Roy Grinnell

FEBRUARY 1973

Tomorrow: Tailgate warning on the windshield

By DAVID LAMPE

It's hard to break the tailgating habit, and a group of British traffic experts know it: They've come up with a simple system that will help you keep your distance



VERTICAL LINES projected on the windshield will move closer together or farther apart, depending on the speed of your car; closer together as your

speed increases and farther apart as you slow down. As long as the outline of the car ahead is between the lines, you are following it at a safe distance

YOUR CAR'S DASHBOARD is supposed to place before you all the information you need to know about the auto's performance at a glance. But a series of tests by the British government's Road Research Laboratory indicates that the present-day dashboard is a distraction.

What's needed is a completely new kind of automobile instrumentation, and the laboratory's technicians believe they have created it. Right now it's being adapted to fit specific models of tomorrow's British autos. And its effect on road safety and driving ease is going to be dramatic.

The British investigators discovered the inefficiency of present-day dashboards about five years ago, when they adapted a device used in American industry, the Polymetrics Eye-marker Recorder, to study what they call "the driving task."

The recorder, which nobody anywhere else had used for this particular purpose, is basically a pair of closed-circuit television cameras that simultaneously photograph and record on tape what a person sees and his eye movements: "When you're driving fast," one of the scientists at the Road Research Laboratory explained, "you hardly ever glance down at your speedometer—although you *think* that you keep a close watch on it. In tight situations, hemmed in by other cars, you never look down at it at all. You can't—because you haven't the time. Whenever your eyes are moving, they're not transmitting information to your brain. Just to glance down from the road ahead to your speedometer, register your speed and then look back down the roadway again takes you at least a second and a half.



IN THE EXPERIMENTAL WORKING SYSTEM all of the apparatus, including optical projector and sloping screen, is exposed. In production models, projec-

tor will be concealed in dashboard and will beam speed and vertical headway markers directly onto windshield. Here, car is following at right distance

"At speed in excess of 70 mph you just don't have the time to take your eyes off the road at all. The study of drivers' eye movements indicate that even on a test track, under ideal weather conditions and with no other cars around, taking into account blinking, 12 percent of the time you're behind the wheel you're not seeing anything at all. And 95 percent of the time you're taking in no information from your dashboard at all. Little wonder that on crowded freeways you're usually driving faster than you think you are.

"Clearly what was needed was some way to place a statement of a moving car's precise speed right in its driver's immediate field of vision." Other Road Research Laboratory studies had indicated that most drivers would be safer if they had some help in stationing their cars on the

road to prevent tailgating at normal speeds. And at speeds in excess of 74 mph *all* motorists could use such help.

The Eye-marker Recorder indicated that drivers usually focus on the roadway about 120 feet ahead of their autos. So the laboratory technicians devised a projector that can be mounted inside a car, in front of the steering wheel, to flash the car's speed on the inside of the windshield or on a rearward sloping plastic or glass screen just inside the windshield.

The British researchers also incorporated into the "head-up" instrumentation system a simple antitailgating device. It projects two vertical lines on the windshield or on the sloping reflector, just above the auto's speed. The lines come closer together when the car races, sepa-

(Please turn to page 193)



ARTIST CHARLES LE NORREYS uses diamond-impregnated grinding wheel to shape leaves and stems

Lucite sculpturing

DIAMONDS are an artist's best friends when he etches and sculpts in Lucite acrylic resin. This is proved by Charles Le Norreys, a young French Canadian whose works are shown here. In fashioning the song sparrow on a milkweed stem (above), Le Norreys first etched in the outline lightly with a diamond-pointed scribe, then he ground the leaves and stems with diamond-impregnated wheels. Seed pods were etched with a hand scribe, the sparrow ground with a steel cutter and final shaping and "feathering" done with a special diamond tool.



SCRIBER (left) is used initially to etch in entire outline lightly, then to etch in details. The "Lancer" shown has interchangeable diamond points, set at different angles—90°, 70° and 60°—for different types of work. In shaping stem of mushroom (below), artist uses flexible-shaft drill with round head impregnated with De Beers natural diamond powder



ARTIST'S WORKS have been on exhibit in New York, San Francisco and Paris. He says he likes to work with diamond tools because of their long life. Most people tend to abuse the scribe, he warns; they use it like a glass cutter rather than the delicate etching instrument that it is. Le Norreys uses both hand and power-driven tools. His flexible-shaft machine is operated from 14,000 to 40,000 rpm, depending on the effect that he is trying to achieve





One scientist suspects that lacquer in hair sprays may collect in human lung tissue. Others are concerned about toxicity of gases commonly used as propellants

By JOHN ENNIS

THE AVERAGE HOME HOLDS small arsenals of aerosol cans in the kitchen, bathroom, basement and garage. This type of dispenser has become so much a part of the American scene that to question its safety seems as gratuitous as an attack on Santa Claus.

But the familiar aerosol dispenser is under investigation. The Food and Drug

Don't take

Administration (FDA) reportedly spends up to \$350,000 a year on aerosol studies and the industry itself is setting aside \$800,000 for related investigations.

The aerosol dispenser first came on the market in the mid-1940s, and since then some 20 billion have been used in the United States. Each year more are sold. In 1970, the last year for which figures are available, an amazing 2.6-billion cans were marketed. More than 300 types of aerosol products are available today, including foods, cosmetics, medicines, paints, insecticides and a host of other household items.

Hair sprays—one of the best sellers—have recently come under suspicion. Dr. John Gowdy of the Food and Drug Administration's division of cosmetic technology says that lacquer from hair sprays may have a tendency to collect in human lung tissue and cause an abnormal condition known as thesaurosis or "storage disease."

The physician made this report after screening 227 beauticians in Montgomery County, Md. X-rays indicated lung abnormalities occurring at a rate 10 to 20 percent greater than in the general population. A number of cases of borderline heart enlargement were also detected.

"One may speculate that the (body's) attempt to remove absorbed spray material imposes a strain on the heart," Dr. Gowdy told a newspaper reporter. The

POPULAR MECHANICS



chances with aerosols!

FDA physician said there are no restrictions on the use of hair sprays because the suspected health problem is without symptoms. He recommends, however, that users take precautions against inhaling the spray.

If you examine half a dozen different brands of hair spray, you're likely to find a variety of warnings on the cans. Some warn against inhalation, some don't.

In the case of hair sprays, it is the lacquer—the product in the can—that causes concern. But how safe is the propellant, the gas used to pressurize the container? Researchers are seeking ways to answer this question.

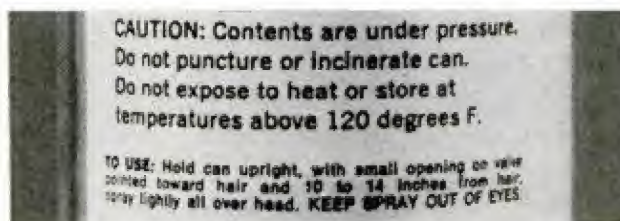
Among the most widely used propellants are the fluorocarbons, gases composed of fluorine, carbon and hydrogen. They are generally thought of as being inert. Nitrous oxide is said to be used as a propellant in some food products and shaving creams, and a gas called methylene chloride in some hair sprays. If administered in sufficient quantities, the last two gases have an anesthetic effect.

One recent investigation—at the Medical College of Georgia by Dr. Nancy C. Flowers and Dr. Leo G. Horan—was focused on the effect of fluorocarbon propellants on heart action. Dr. Flowers is chief of the cardiology section at the Veterans Administration Hospital, Augusta, Ga.

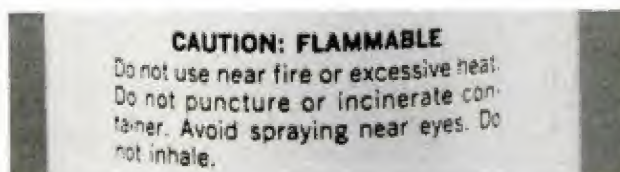
Sixteen dogs were used. Six were al-

FEBRUARY 1973

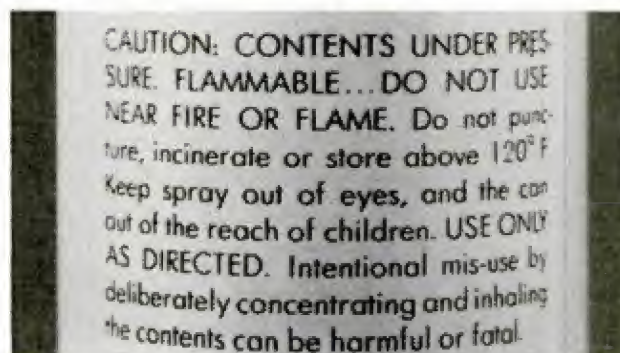
lowed to breathe a combination of oxygen and fluorocarbon gases, while 10 breathed the same aerosol propellants mixed with room air. Heart action was



NO WARNING against inhalation of vapor appears on hair spray bought for purposes of this article



A FULLER WARNING is carried on second brand. All cans purchased cautioned against heating container



NEW ANTISNIFFING WARNING appears on third can. You can expect to see this caution on more sprays

closely monitored by means of cardiograph machines.

"Within seconds to minutes of aerosol inhalation," the researchers report, 13 of the animals developed irregular heartbeats. Administration of the propellant gases was stopped at the first sign of cardiac irregularity. Despite that, eight of the dogs died.

The data obtained in this investigation led the two researchers to say that "the would-be sniffer cannot depend upon subjective warning sensations in order to stop 'in time.'"

The safety aspect of aerosols was never questioned until the late '60s, when cases of deaths due to the deliberate sniffing of aerosol vapors began to crop up. Since then an estimated 200 persons—most of them under 20—have died while attempting to get "high" by inhaling aerosols.

Needless to say, the industry is concerned. Since 1969 it has conducted an educational campaign to warn young people and adults of the dangers involved in aerosol abuse.

The Aerosol Education Bureau, an industry group, sends out warning memorandums and brochures to the press, law enforcement and health officials, schools, colleges and civic groups. A typical fact sheet warns that "deliberate inhalation . . . of concentrated amounts of aerosol vapors with the intent of intoxication can lead to death. The major cause of death



TEST TO IDENTIFY CHEMICALS in lung tissue is done at the Southwest Research Institute, where aerosol study is underway

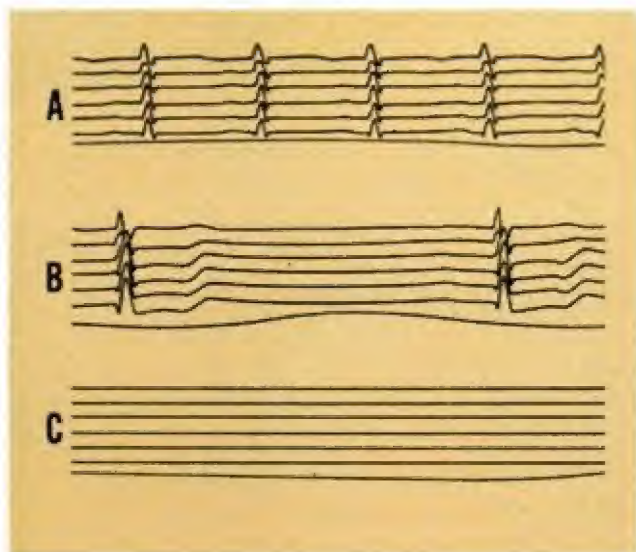
is heart arrest, although it can come through asphyxiation. Death comes without warning. It can happen the first time or the fifth. There are no safeguards. There are no antidotes."

In the summer of 1972, Dr. Charles Edwards, commissioner of the FDA, made it known that his agency was considering making it a requirement that spray cans carry a specific antisniffing warning. Many manufacturers took the hint.

"Eighty to 85 percent of units on the shelves have or soon will carry an anti-sniffing warning," says James Merritt, president of the Cosmetic, Toiletry and Fragrances Assn., a trade organization. The warning, shown in the bottom label on page 83, states: "Intentional misuse by deliberately concentrating and inhaling the contents can be harmful or fatal."

Deliberate abuse is one aspect of the problem. But—as indicated by the beautician study—scientists are also concerned about the possible harmful effects the normal use of aerosols have on lung tissue. Another investigation focused on this aspect is being carried out at the Southwest Research Institute in San Antonio, Tex., under the direction of Dr. James Bollinger, senior biochemist. The National Institute of Environmental Health Services is sponsoring the study.

In one part of the investigation, rabbits and rabbit lung tissue are exposed to various airborne substances, including aerosol propellants. Molecular structural changes in tissues are being studied by means of sophisticated spectroscopic tech-



ELECTROCARDIOGRAM shows a normal heart rate (A) of laboratory animal. After breathing gas mixtures, heart action slows (B) before coming to a stop (C)



New dispenser needs no gas

The gas propellant in the typical aerosol can may contaminate a food product and change its taste. If heated, the container can explode. These shortcomings reportedly are eliminated in a new type of dispenser called Selvac, which does not use a gas. According to its maker—Plant Industries, Inc.—Selvac contains a patented elastomeric bladder that stretches like a balloon when filled with a product and takes the shape of the outside container. When the valve is opened, the bladder squeezes out the product. Because of relatively low pressure, Selvac works best with thick substances such as shampoo and suntan lotion. The company claims the bladder squeezes out up to 98 percent of its contents. In photo, dispenser at extreme left is empty; the bladder in container next to it is filled.

niques. Since the study is still in progress, no results have been reported.

But, in a telephone interview, Dr. Bollinger told *PM*: "While no one knows the harm done by normal daily use of aerosol products, the ingredients in many of them appear to cause alteration in lung tissues."

Some scientists fear that even in normal use fine sprays may go deep into the lungs, where chemicals can damage tissue and invade the bloodstream. Some spray products—notably deodorants—contain talcum powder or metals like zinc and aluminum. Recently, FDA investigators discovered asbestos and other foreign particles in several aerosol cosmetic products. Asbestos is a toxic substance.

Hexachlorophene (HCP), which was first marketed in 1940, was not banned

by the FDA until 1972. The once-common ingredient in feminine sprays and family deodorants was taken off the market, according to Dr. Edwards, "because under certain circumstances, HCP is a very, very potent neurotoxin." In short, it's capable of damaging nerve tissues.

The Givaudan Corp. of Switzerland, which produces tons of HCP yearly, charged that the FDA's decision was based on an "emotional or perhaps hysterical reaction to a gross human error in France," where the chemical was responsible for the deaths of 40 infants. A company official said that to deny the world the use of this product is "a tragedy in itself."

Dr. Sidney Wolfe, director of the Ralph Nader Health Research Group, charged that the FDA's ban was "tragically tardy" in view of his organization's earlier findings. The Nader group had issued a warning 10 months prior to the FDA ban.

While antisniffing warnings may become a familiar sight on cans, the FDA will not require spray products to carry a warning about potential dangers resulting from everyday use. "The reason for this," says an FDA official, "is that we do not believe that normal use of aerosols presents a significant health problem."

That view is shared by Dr. F.A. Bower, director of aerosol research and development at the DuPont Corp.'s Freon Div. DuPont Corp. is the nation's largest producer of fluorocarbon propellants. Writing in *Aerosol Age*, a trade publication, Dr. Bower states that evidence accumulated to date indicates that physiological effects are not produced by fluorocarbon gases at the low levels of concentration associated with normal use.

"Some recent tests performed by Freon Products Laboratory using commercial aerosol products," he continues, "show that when used normally, the exposure level to propellant is very low . . . Other studies designed to assess the exposure level of a high-exposure group—professional hair dressers—showed that these workers were exposed to no more than .005 of 1 percent fluorocarbons."

The aerosol controversy has just begun. Americans will continue to use this handy dispenser, but until more is known about the possible hazards, caution is the consumer's best protection. ★★★

MITS 1440
\$199.95 kit
\$249.95 assembled

Miida 1214
\$199.95

Crown CL-120T
calculator/clock-radio
\$229.95

Canon
Pocketronic
\$249

Panasonic 850
\$139.95

Heathkit
IC-2008
\$109.95

Aries AR-410K
kit \$99

Casio Mini
\$59.95

Bowmar Ten
\$150

Phoenix Mini
\$100

Electronic calculators:

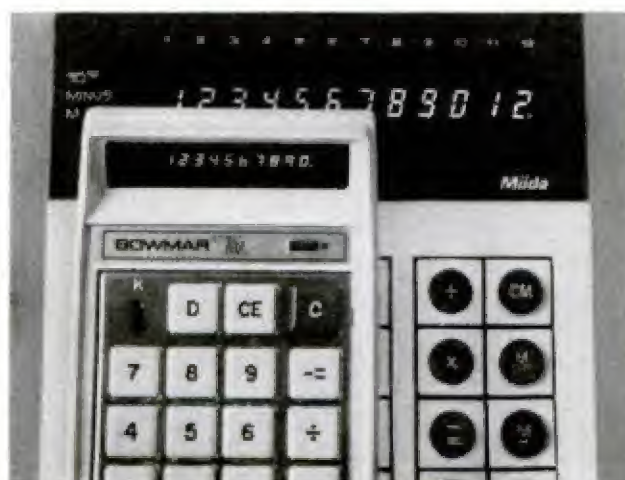
They add, subtract, multiply and divide—silently, accurately, as fast as you can push their buttons. Now they're at prices you can afford. But with hundreds to choose from, which is right for you?

By IVAN BERGER, Electronics Editor
Photos by Steve Fay



STYLISH PANASONIC is a bit big for most pockets. It comes with case, recharger and two battery cases

POPULAR MECHANICS



POCKET-SIZED CALCULATORS live up to name (top). Battery-powered, they can be used anywhere (left). But their numerical displays are smaller, and their keys more cramped than those on desk models

How to choose the right one



SMALLEST PRINTING CALCULATOR is Canon Pock-e-tronic. But more are coming, from other companies

CALCULATORS used to be heard more than they were seen, kerchunking like consumptive time bombs in large offices. Today, you'll see calculators in almost every office, office-supply store and department store, and in thousands of homes. But you won't hear them: Aside from an occasional, muffled keyboard click, they're totally silent. And today's calculators are ultrafast (you get most answers before you've even finished releasing the keys), inexpensive (starting at around \$60) and so compact you may have seen housewives whip them from their purses to check price totals, or relative per-ounce costs at your local supermarket.

Adding machines have been available at comparable prices for a few years now,



DECIMAL SWITCH (arrow) on Miida can be set for fixed or floating decimals. Floating-decimal answer (left) shows all decimal places that will fit



on the display, cuts off others. Fixed decimal settings demonstrate round-off: two-place setting (center), useful for dollars and cents, rounds 1.555

but a calculator does a lot more. It adds (though usually without the paper tape that helps the adding-machine operator recheck his figures), subtracts (showing negative results directly as a "credit balance," not as the puzzling "reciprocal" at the end of a long string of 9s that most home adding machines give you), and multiplies and divides, too.

It took two electronic developments to make today's calculators so swift, silent, versatile and cheap. One was the invention of whole families of readout devices that can light up (or reflect light) to show any number from 0 to 9. The other, and more important one, is Large Scale Integration (LSI), that can put thousands of transistors, diodes, resistors and capacitors on a silicon square no wider than two lines of this type are high.

As new LSI chips, readouts and keyboards are developed, the calculators become ever more sophisticated. But their prices are dropping so fast we could only include the roughest price guide-lines in this article—and even they are certain to be outdated by the time this reaches you.

As prices drop, calculators are finding their way to more and more unusual applications. Bowmar, probably the largest calculator manufacturer, found many such uses in a recent survey: Salesmen use them to compute estimates and prices for carpeting and fences. A professional pilot carries one for navigational calculations. A housewife with three skeet-shooting sons checks shooting-record cards. A lawyer carries one abroad for foreign currency conversions. An amateur astronomer checks star position angles. A teen-

aged girl adds up the individual times of records she's copying onto cassettes. An accountant's girl friend uses his when she plays banker in Monopoly games.

People in all walks of life use them to check bank statements, telephone and credit card bills, restaurant bills and tips, income taxes and automotive mpg.

You probably have a use for a calculator, yourself. But with about a hundred brands on the market, how do you pick the right one?

You start by deciding how you'll use it. Will you need to carry it from class to class in school, to use it in your car, to carry it with you to the supermarket? Then you'll need a battery-operated pocket-sized model (\$60-\$400); just make



EXTRA FUNCTIONS on MITS 1440 include square root, square, memory (with + and - inputs, independent clearing). EXC key exchanges dividend and divisor for some complex calculations. D key sets decimal

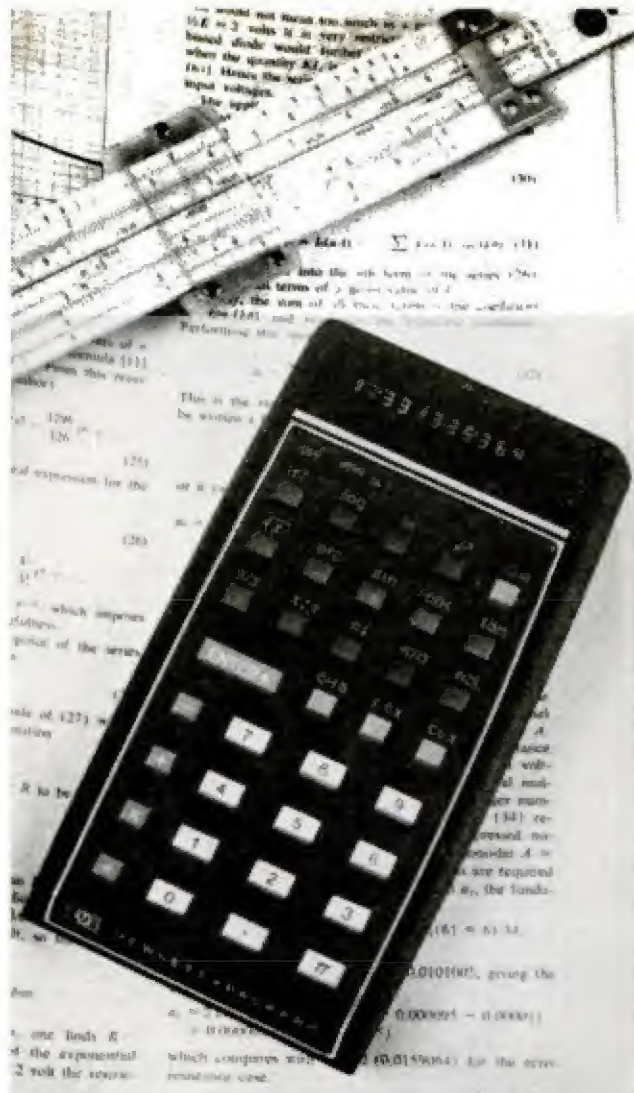


. . . to 1.56; whole-number setting (right) rounds it to 2.0. Most of the machines just cut off remaining digits (as does the Miida, if they're 4 or under)

sure it's small enough to fit the pocket you intend to carry it in (Busicom and Ragen have cigaret-pack-sized models—any smaller and you couldn't work their keys), yet big enough not to fall out.

If you'll use your calculator in one place all the time, try a desktop model (\$80-\$5000). Powered by a.c., it never needs battery charging or replacement, and its larger numbers and wider keys are more convenient for long work sessions.

More elaborate (and expensive) desktop models have many extra features, such as one-step percentage and square-root keys, 12-digit and larger displays (most pocket calculators have 8 digits, though the Bowmar Ten and the Hewlett-Packard have 10), several memories and even



ELECTRONIC SLIDE RULE, \$395 Hewlett-Packard HP-35 holds "stack" of four complex numbers, does trig functions, logs, natural logs, square roots, inversions, pi, decimal powers, and powers of e, expresses numbers in normal or scientific (powers of 10) notation



SUN-SHADE on this apf Mark V (under \$100) is linked to on-off switch; close it, and the calculator shuts off. Between keyboard and display are battery meter, constant switch, fixed/floating decimal switch



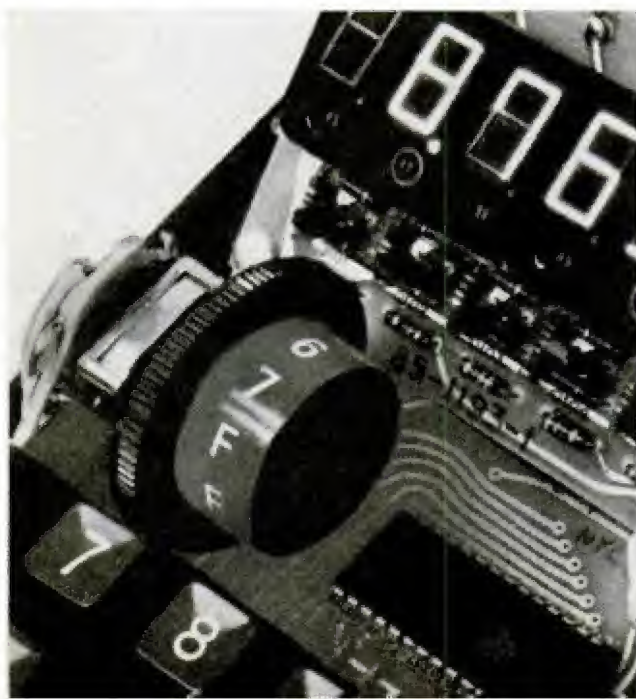
THE PERFECT EXECUTIVE TOY, this Crown CL-120T is a handy compendium of electronics for the desk: a calculator combined with an AM/FM clock-radio. Also available: a calculator/cassette combination



KITS: Heath IC-2008 (rear) is \$110, has fixed and floating decimals, takes six hours to build. Aries (lower left) costs \$99, takes six hours. MITS 1440 (\$200 kit, \$250 wired) takes 15 hours because of memory and other functions (see page 88)



COMPONENTS shown build Aries calculator with fixed decimal, 16-digit overflow, zero suppression



programmers that store the instructions for complex calculations, so all you have to enter are the figures themselves.

There are also portable models (about \$80-\$300), basically small, desktop machines that run on batteries and a.c.; they're great if you keep one at your desk but must occasionally bring it home for weekend overtime.

If you buy a battery-operated model, make sure its batteries will run long enough between charges or replacements for your intended use; portables, having room for more batteries, generally run longer. Some models use throwaway, replaceable batteries; make sure these batteries are of a readily available type, and that the battery compartment is sealed (or, better yet, removable) to confine damage from leaky cells.

Check the required charging time for units with rechargeable batteries—some machines need less charging time than others (but most calculators can be used while they're being charged). For maximum convenience, look for models (like the Panasonic) which supply both rechargeable and dry-cell power packs. Since low batteries can cause calculating errors, most portable and pocket models have some sort of low-battery indicator on the display or as a separate meter.

The display can affect battery life, too. Self-illuminated displays, though the easiest to see in dim light, use more power than liquid crystal types, which work by reflected light (and which are less likely to "wash out" in bright light). But some self-illuminated units have battery-savers that shut the display off after 15 or 30 seconds, turning it on again when you press a key. A few machines, such as the \$249 Canon Pocketronic (see page 87), have no readouts. Instead, they print out their results, with thermal printers that make no more noise than gently popping corn.

The keyboard can tell you a lot about what a machine can do. If there's a decimal point and a switch marked "0-2-4" or something of that nature, the unit has *fixed decimals*, and the decimal point in the answer will fall as many places from the right edge of the display as you've

(Please turn to page 192)

SINGLE INTEGRATED CIRCUIT (lower right) holds all calculator circuitry of this Heathkit; other circuits shown drive the display. Thumbwheel selects floating decimals (F) or 0-7 place fixed decimals

Thorp's two-seater is a flying 'Tiger'

This little beauty combines sleek looks, zippy performance and easy construction

By **SHELDON M. GALLAGER** and **HOWARD LEVY**

Photos by Howard Levy

ONE THING YOU CAN SAY about the Thorp T-18 *Tiger*—it really gets around. Ninety of the popular home-grown two-seaters have already been built and flown, and more than 100 more are reported under construction. Nine are operating in rugged Australian and Canadian bush country, and others are flying far and wide throughout the world. One doctor uses his T-18 to make house calls in the vast, remote regions of rural Nebraska.

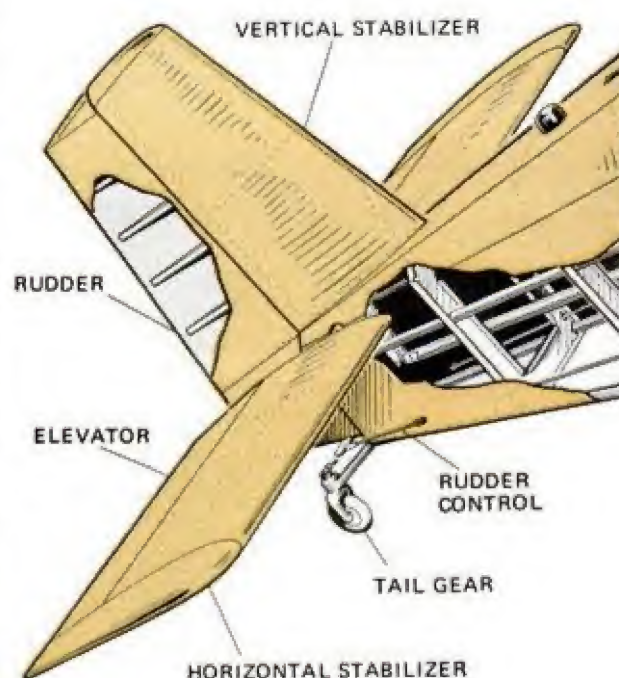
There are reasons for the praise and affection homebuilders have for this gutsy little low-winger. Developed by aeronautical engineer John Thorp, it's designed especially for easy homebuilding, making it a natural for beginners. It also has im-

pressive flight characteristics, living up to its name as a tough, tigerish, scrappy performer. With a 150-hp Lycoming engine, it hits up to 190 mph, cruises at a brisk 170 and climbs 2000 feet a minute to a service ceiling of 18,000 feet—that's really getting up in the wild blue yonder! It has a range of 550 miles on a 29-gallon tank, weighs 1450 pounds fully loaded and takes off in 800 feet. Its dual controls are handy for sharing flying chores with a companion on long hops.

Underneath the deceptively sleek exterior is a surprisingly simple airframe. The all-metal parts need no jigs for assembly and go together like an Erector set. The fuselage is straight-sided and

DESPITE CLASSY LOOKS, plane is designed for easy home building by eliminating tricky compound curves

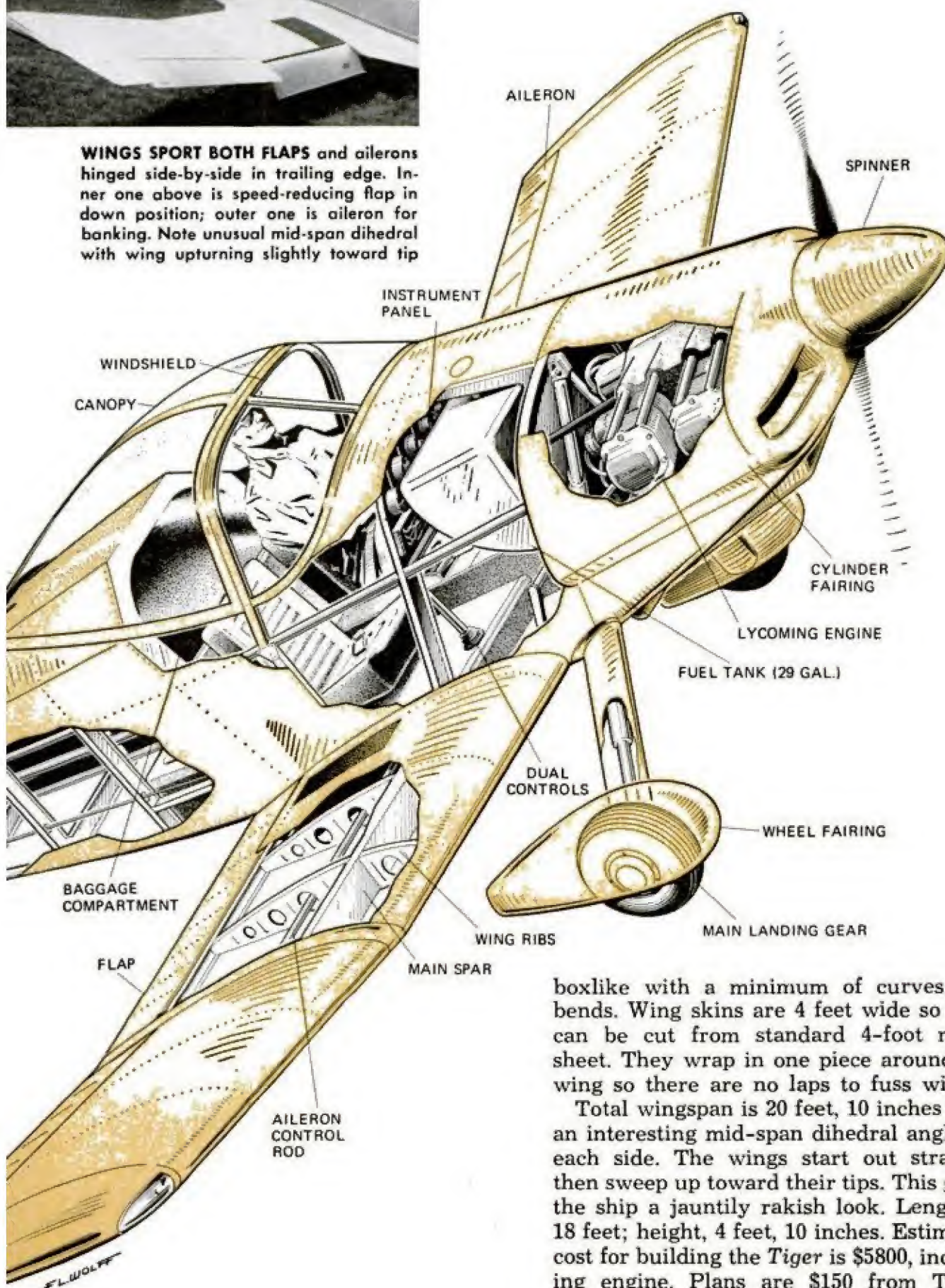




SIMPLE FUSELAGE (top photo, left) shows why T-18 is so easy to build. Ship is slab-sided with minimum of curves and bends. Streamlined nose cowling, prop spinner, wheel pants and other smart touches are what turn this plain Jane into the jazzy-looking little beauty shown at bottom. Cockpit view (center photo at left above) shows dual joy stick controls and elaborate instrument panel. Powerplant is a 150-hp Lycoming engine, giving the fleet-winged Tiger an impressive top speed of nearly 200 mph



WINGS SPORT BOTH FLAPS and ailerons hinged side-by-side in trailing edge. Inner one above is speed-reducing flap in down position; outer one is aileron for banking. Note unusual mid-span dihedral with wing upturning slightly toward tip



boxlike with a minimum of curves and bends. Wing skins are 4 feet wide so they can be cut from standard 4-foot metal sheet. They wrap in one piece around the wing so there are no laps to fuss with.

Total wingspan is 20 feet, 10 inches with an interesting mid-span dihedral angle on each side. The wings start out straight, then sweep up toward their tips. This gives the ship a jauntily rakish look. Length is 18 feet; height, 4 feet, 10 inches. Estimated cost for building the *Tiger* is \$5800, including engine. Plans are \$150 from Thorp Engineering Co., Box 516, Sun Valley, Calif. 91352.

★★★

PM OWNERS REPORT: VOLVO 140 SERIES

Owners toast long life and



BREADBOXY LINES don't quicken much blood, but owners didn't complain about styling either. Volvo has face-lifted basic 1966 144's unit body several times, but all years tend to look alike. Squared lines give great trunk capacity, with even a hidden well opposite the spare tire. Among praiseworthy features are 360° visibility, thick steel panels, stainless trim, standard radial tires. Some owners complained of easy-to-scratch paint, but everyone agreed that it was well sprayed and smooth.

By **MICHAEL LAMM**
West Coast Editor

Photos by the author



VOLVO OWNERS aren't the fickle sort who trade cars every couple of years. Half those we surveyed figure they'll keep their cars at least five years; 25.6 percent said they plan to hang on 10 years or more.

Volvo ads claim that in Sweden, Volvos last an average of 11 years. Here in the United States, the average life span of a car is eight years. Does that mean Volvo is better-built than domestic makes? Read on and make up your own mind.

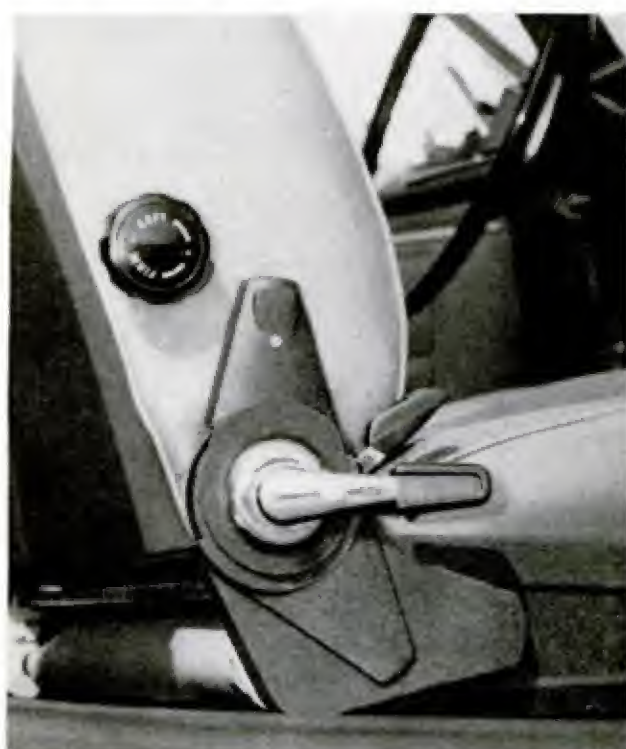
Volvo enjoys a worldwide reputation

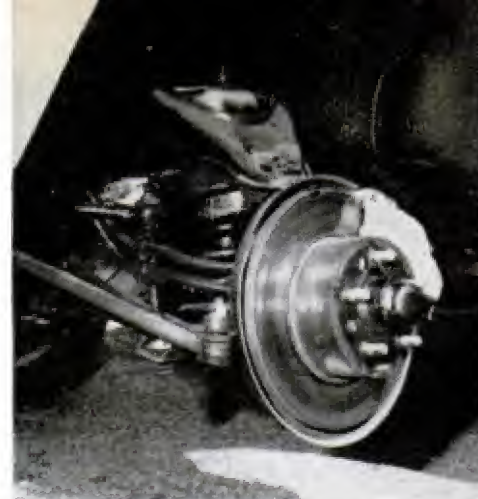
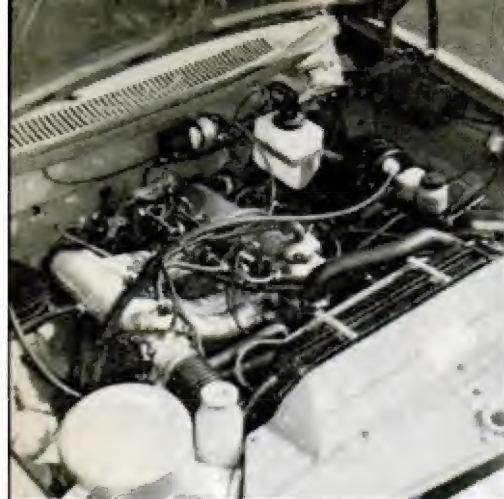
for quality and good value. It grew mostly during the 1950s and early '60s when the PV series and the 122-S became popular. The PV and 122-S were relatively inexpensive, very well put together, lively cars that gave long, troublefree service.

In 1966, Volvo introduced the 144, for the 1967 model year. It used basically the same B-18B four-cylinder engine and unitized body shell as today's 144 sedan. Since 1966, Volvo has added two more body styles in the 140 series—a two-

POPULAR MECHANICS

wish for shorter ETs





ALL 1973 VOLVOS use Bosch electronic fuel injection, which gives increased horsepower and fewer pollutants than previous two-carb setup. Tall items

lems keeping the standard two-carb setup in tune. Rough idle, dying and hesitation on acceleration were common symptoms. There don't seem to be enough qualified mechanics to go around—another common complaint. "I once broke down near a small town in Pennsylvania and couldn't find anyone who knew enough about the car to do more than tinker with it," says a Virginia college professor. Other owners gripe that Volvo dealers too often "dual" with other makes—sell other brands of cars in addition, which makes Volvo something of a bridesmaid.

The fuel-injection setup, as opposed to twin carburetion, is relatively troublefree. Interestingly, the electronic control unit ("computer") for the f.i. rests beneath the driver's seat, away from engine heat, fumes and possible moisture.

Most Volvo owners bought their cars unemotionally. Styling ordinarily plays an important role in choosing a new car, but not this time. Volvo's conservative styling didn't turn anyone on, but no one com-

can't be stored in door pocket because of armrest. Four-wheel disc brakes make for sure, fast stops, and there weren't many gripes about rotor squeal

plained about it either. Volvo's breadboxy look gives it tremendously usable interior space, and owners appreciate the cavernous trunk (15.6 cubic feet) and generous legroom front and rear.

Other points of praise were the four-wheel disc brakes and the excellent seat-belt shoulder-harness arrangement. Volvo owners tend to be safety conscious, and many cited the car's good all-around visibility.

In our survey, 13.2 percent bought new Volvos on the basis of past experience. What do these owners think of their new cars in comparison with older models? "I previously owned a 1970 145-S and must say the '72 injected car is much more satisfactory," says a Wisconsin artist/instructor. A Massachusetts architect: "This '72 feels much stronger than my 1970 Volvo without fuel injection—I highly recommend fuel injection." And an Ohio draftsman: "Much more responsive than my '68."

Even so, "more power" came up as the



THE 142 SEDAN is only one of the 140 series. Other models are 144 four-door and the 145 station wagon



IT'S A LONG REACH to glovebox for driver, but it holds plenty with its drop-down, breadbasket design

POPULAR MECHANICS

primary would-like-to-see. Volvo owners aren't actual racing types who run elapsed time (ET) in the quarter-mile, and the plea for more horses isn't desperate, but it is consistent. Perhaps part of their reasoning springs from an on-paper decrease in Volvo's horsepower rating last year. For 1971, all automakers still advertised gross horsepower ratings, and Volvo's figures were 130 bhp for the injected four-cylinder and 118 for the carbureted version. In 1972, with the industry's switch to net figures, these same engines rated 112 and 97 bhp respectively. Actual power remained the same. So the lack-of-power complaint might be partly the effect of semantics and partly based on the reality of having to row in emergency situations and at stoplight drags.

Solid, sturdy construction came up time and again as one of Volvo's more praiseworthy qualities. To back this up, here's a comment from an Alabama conservation analyst: "We had our 145 wagon less than two months when we were hit in the side by an Oldsmobile. Although it did \$700-worth of damage, no one was injured. The seat belts did their job well. We feel these and the Volvo's construction were responsible. Since then it has been repaired and runs like new."

On the general topic of quality, these comments: "Superior design assembled from quality materials by men who take pride in their work." "Excellent; stainless steel trim and heavy-gauge body metal resist denting." "Outstanding," says a Colorado Air Force administrator, "because my father bought a top-line 1972 Chevy, and the Volvo is far superior in workmanship and attention to detail."

As to comfort, a New York school teacher says, "Reclining front seats with lumbar adjustment are very comfortable." A Brooklyn physician: "Plenty of room in the wagon for long trips." A Massachusetts photographer: "Hard ride and noisy engine." A New Jersey veterinarian: "Steering is very heavy; needs power steering."

A New Jersey insulation engineer wraps it up: "I feel cars like the Volvo, Saab, Audi, etc., will continue to get a good percentage of U.S. sales until American manufacturers can produce a reliable, quality car that has a long list of comfort and safety features that are standard not just because the government requires them but because they make a better, safer car." That plus the high regard for workmanship and longevity pretty well sums up Volvo ownership. ★ ★ ★

Summary of Volvo 140-Series Owners Reports*

Total miles driven	2,504,888
Average miles per gallon	
Carbureted:	
Local driving	19.6
Long trips	22.7
Fuel-injected:	
Local driving	18.9
Long trips	21.7
Engines:	
Carbureted	43.3%
Fuel-injected	56.7
Transmissions:	
Four-speed manual	64.8%
Automatic	35.2
Series :	
142 (two-door)	35.5%
144 (four-door)	23.4
145 (wagon)	41.1
Why the Volvo?	
Economy	23.9%
Reputation	20.6
Workmanship	15.6
Size	14.4
Quality	13.6
Past experience	13.2
Specific likes:	
Handling	53.0%
Comfort	48.2
Economy	33.6
Workmanship	24.3
Brakes	21.9
Performance	15.8

Size	15.0
Ride	15.0
Specific dislikes:	
Rattles	19.5%
Dealer service poor	18.3
Hard steering	8.1
Lack of power	8.1
Poor gas mileage	6.1
Cold starting	6.1
What changes would you like?	
More power	12.4%
Better air conditioner	8.9
Better materials	8.0
Power steering	8.0
Bigger engine	7.6
Had any mechanical trouble?	
Yes	62.5%
No	37.5
What kind of trouble?	
Carburetor	15.6%
Air conditioner	11.7
Transmission	9.7
Clutch	7.8
Brakes	7.1
Cold starts	6.5
Did you repair it yourself?	
No	92.3%
Yes	7.7
Dealer repairs satisfactory?	
Yes	70.6%
No	29.4

Dealer service opinion:	
Good to excellent	47.6%
Fair to poor	52.4
Is the Volvo your only car?	
No	54.9%
Yes	45.2
Other cars owned:	
Volkswagen	18.4%
Chevrolet	17.6
Volvo	13.2
Ford	8.8
Pontiac	8.1
How long do you plan to keep your Volvo?	
0-1 year	2.5%
2 years	3.4
3 years	5.9
4 years	13.9
5-6 years	24.8
7-9 years	20.2
Over 10 years	25.6
"As long as it lasts"	3.8
Workmanship opinion:	
Good to excellent	83.1%
Average to poor	16.0
Age distribution of owners:	
15-29 years	38.0%
30-49 years	43.7
50-plus	18.4
Would you buy another Volvo?	
Yes	87.1%
No	12.9

*Percentages might not equal 100% due to rounding and/or insufficient data.

Workshop Editor
Popular Mechanics
224 West 57th Street
New York, N.Y. 10019

Dear Editor:

I am 15 years old. I built my shop one year ago with the supervision of my uncle. Neither of us were greatly skilled in carpentry, and no plans were drawn, (we planned as we went along).

My shop is a replica of an old English barn. It is 12' wide and 17' long; it has a gambrel roof, double doors, and a hayloft where lumber is stored. On one wall a bench runs the full length of the shop with my woodworking tools hanging above it. On this bench is my drill press and vise. In the middle of the shop is my table saw. On the opposite wall is my woodworking lathe with the lathe tools hanging above it. Next to the lathe is my metalworking bench. In the rear of my shop is a window with a cabinet beneath it that houses my power tools. In front of my table saw, in the center of my shop is an empty space where large projects can be set up on sawhorses.

My shop is not the world's largest, nor can its interior compare to those published in your magazine, but its architectural design makes it a very unique shop, and I am sure no other teen-ager in the world owns a shop quite like mine.

Sincerely,

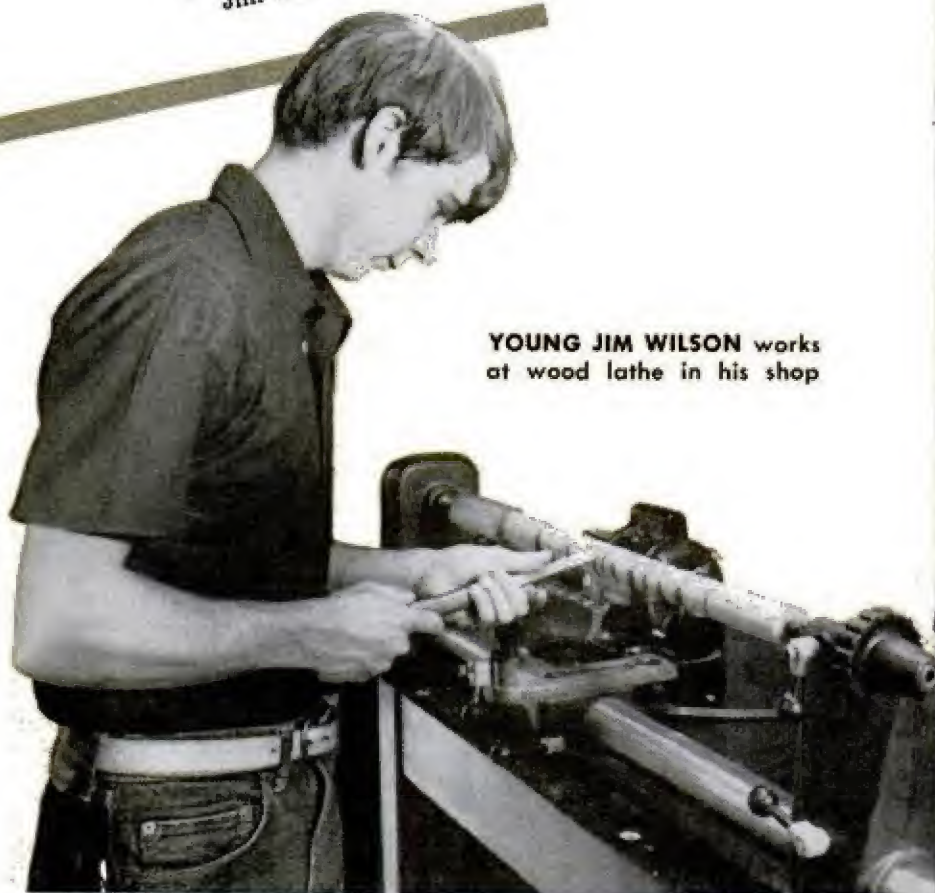
Jim Wilson
Jim Wilson

ACTUAL LETTER from 15-year-old craftsman proves it's never too early to start taking an interest in tools and shop work

One (young) man's shop

By JAMES H. PICKERELL

YOUNG JIM WILSON works at wood lathe in his shop



JIM WILSON is 15 years old. The only thing unusual about this is that he's a 15-year-old who owns and operates his own workshop. Some novel features are that it's a separate outbuilding attractively patterned after a quaint Old English barn with gambrel roof, was built by Jim himself with help from an uncle, and is well equipped with tools and machines picked up here and there at modest prices, proving you don't need to spend a fortune to have a good workshop.

Jim, who lives in Laurel, Miss., has been following PM's "Great Workshop" series and thought we might like to see the results of his own efforts. We think PM readers might, too. Jim's shop is not as fancy as some, but it's a start—and a good one—one to be justifiably proud of. Not many teen-agers have their own places for constructive work; if they did, there would be fewer hangups in today's harried world. A common interest in tools and hobbies and an enthusiastic pride in good craftsmanship are great gap closers between generations.

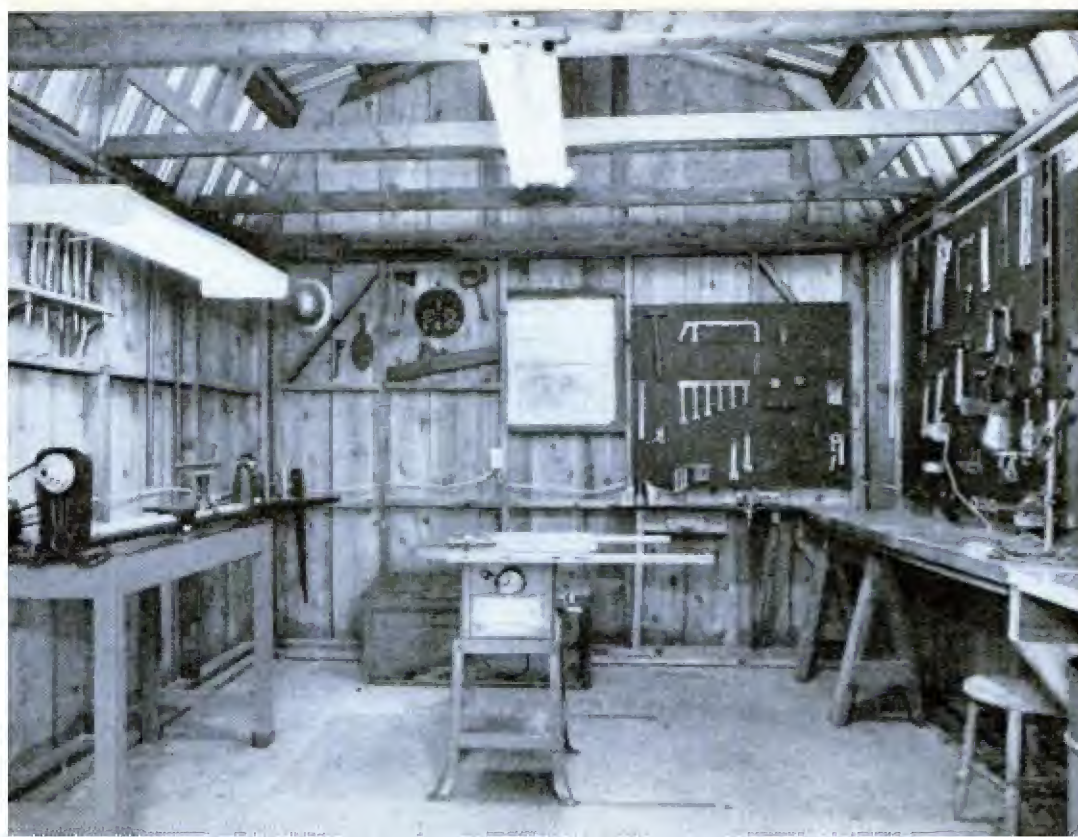
Jim started out by commandeering a corner of the family garage for a workbench, but it soon became obvious that this would not provide the kind of space and facilities the young craftsman had in mind. Besides, people kept wanting to put a car in his "shop." When Jim's father passed away a few years ago, an uncle offered to help the boy build his own shop, and an aunt agreed to contribute.

It was decided that a separate building

in the back yard would be the only solution—something with big doors to move bulky gear through, enough open floor space to maneuver around in easily and plenty of storage room for lumber and supplies. For a pleasant, rustic appearance, the building was to be styled after an Old English barn, calling for a gambrel roof. The choice proved both a blessing and a headache. The complicated, multiangled roof, though tricky to build, provides good headroom and storage.

Construction was begun with nothing more than a picture of a typical English barn to work from. Floor area was determined to some extent by the size of concrete blocks available for foundation walls. Since no one wanted to get into cut-

(Please turn to page 200)



GAMBREL-ROOFED workshop in back yard of Jim Wilson's home in Laurel, Miss., is rustic and homey as well as providing roomy work area. Note bench-lined walls with table saw in center for easy access from all sides (left). High-rising gambrel-roof design adds spacious upper loft for storage of lumber and supplies. Workshop size is 12x17 feet

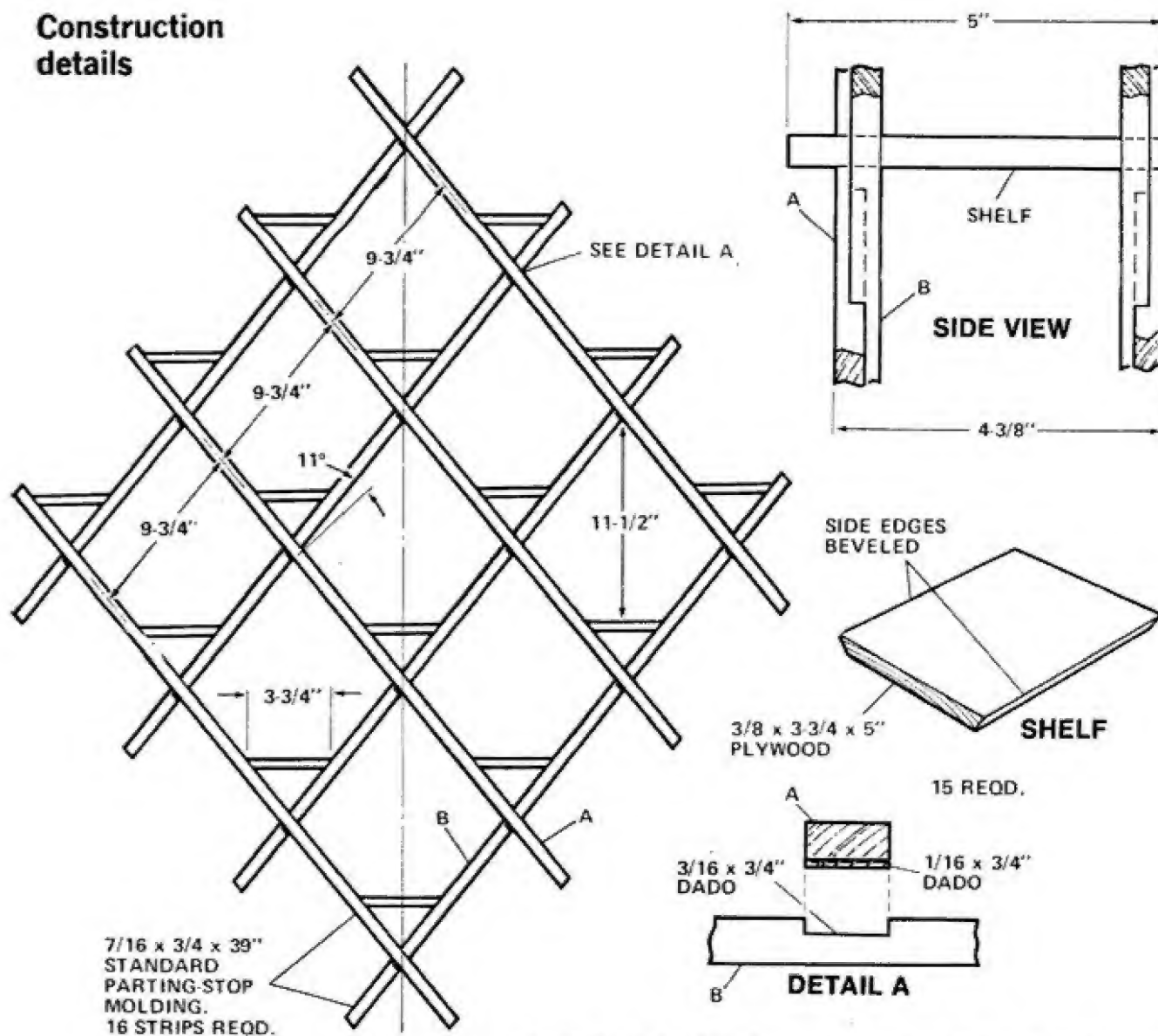
Flower garden on your wall

THIS COLORFUL PLANT TRELLIS is a decoration that literally "grows" on the wall. Fifteen potted plants give it an ever-changing look as new foliage and blossoms appear.

It consists of two identical frames of crisscrossed strips spaced apart by 15 shelves. The strips are lumberyard moldings which measure approximately $\frac{1}{2} \times \frac{3}{4}$ in. You'll need 16 strips (39 in. long)—8 dadoed $\frac{3}{16}$ in. deep and 8 dadoed $\frac{1}{16}$ in.

deep—to automatically register one strip over the other. The dadoes are cut with a table or radial saw, and with a stop attached to the fence to space the cuts uniformly $9\frac{3}{4}$ in. on centers. The blade, or the miter gauge, as the case may be, is set 11° left of 90° ; the same setting is used in dadoing all 16 pieces. The ends of the shelves are beveled to suit and then the shelves are glued even with the front and back strips. ★★★

Construction details



WHITE-PAINTED TRELLIS with its red, yellow and green pots contrasts beautifully when hung on a dark paneled wall (right). A couple of screws through holes in back strips are used to hang the unit. The plastic pots, measuring $3\frac{1}{2}$ in. in diameter and $3\frac{3}{8}$ in. tall, cost 39 cents each at S.S. Kresge stores





EMISSIONS TEST of an i-c engine with electronic fuel injection is conducted at the Bendix laboratories

Can Detroit save the i-c engine?

By ROBERT LUND, Detroit Auto Editor

HOW LONG BEFORE DETROIT junks the internal-combustion engine? How many more model runs can the old geezer survive before he's put to pasture—or can he be saved?

The i-c engine has been around forever, longer than the automobile itself. He's been a hard worker, loyal, dedicated and all the other compliments they engrave on the retirement watch. But the years have caught up with him and he has developed a long list of afflictions in his old age.

He has become a lush with an insatiable thirst for gasoline. His parts wear out or conk out. He's expensive to repair. He's gone to fat and become too big for the space he has to be squeezed into under

the hood. He's a maze of makeshift plumbing, attachments and tentacles. Noisy. Cantankerous in cold and damp weather. If that's not enough to qualify him to be pensioned off, consider the charge that he's a leading contributor to air pollution and a threat to human health.

Before Detroit can dump the i-c engine, it has to come up with something to replace it. Something better. But what?

The answer is that there isn't anything better than the i-c engine—piston version or Wankel—in prospect for the next four or five years.

Since the federal government moved into the auto business, it has received more than 100 proposals for engines to replace the i-c engine. Most have been paper projects or theories. Few of these

ideas have been accompanied by working models.

The best idea of the lot is the turbine, which some authorities foresee coming on cars in small volume around 1976-77.

That's not to say all the other ideas for engines to succeed the i-c engine are without merit or that they'll never be put in production. But steam cars, battery/electric cars, solar-powered cars and the 90-some other candidates vying to take over are long-range propositions.

You'd expect Detroit to take that position, to look down its nose at any alien recruit that might threaten the billions the auto companies have invested in plants and machinery to produce i-c engines. Self-protection. But listen to an expert who looked at all the alternate forms of power for cars without personal interest in who wins the race. The speaker is Dr. Lee A. DuBridge, former science advisor to President Nixon:

"No one has yet invented a replacement for the i-c engine that has adequate performance, reliability and safety, or that can be produced at a reasonable cost and require a minimum of maintenance.

"When you get down to the hard facts of life—considering all sources of energy and the present state of the art—the most practical avenue for real progress in vehicle emission in this decade is to finish cleaning up the internal-combustion engine."

If Dr. DuBridge and other champions of the i-c engine are right, that puts a different twist on the question. It's not a matter of when Detroit's going to dump it. It's what can be done to save it, patch it up and keep it going until an acceptable replacement comes along.

The i-c engine might be forgiven its other faults if it could be cleaned up. That's what most of the opposition amounts to. It's a polluter. The auto firms figure if they can correct the pollution problem, most criticism will disappear.

What's the industry doing to reform the old reprobate?

The engine is being redesigned and refined. New hardware is being developed to change the way gas burns inside the engine and to purify emissions before they're discharged into the atmosphere. The oil companies are being asked to develop new fuels that will burn cleaner.

The engine add-ons will include elec-

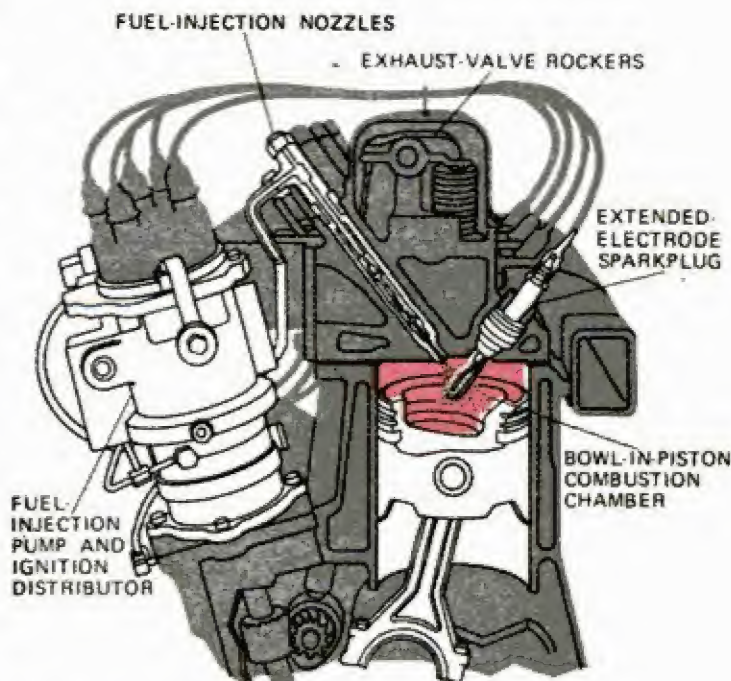
tronic ignition (standard on Chrysler cars now, coming on all other makes within two years) and electronic fuel injection (e.f.i.). Electronic ignition prevents misfiring at low speeds. You don't let go with a blast of blue fumes when you start the car.

E.f.i. senses all operating conditions and gives optimum combustion at every speed. The mixture of air and fuel is adjusted according to need. Increasing the amount of air mixed with the fuel results in more complete combustion, reducing output of carbon monoxide and hydrocarbons.

E.f.i. is probably not more than a year away. Not as a mass production proposition, but in limited volume that, over a period of say three to four years, will extend to all cars. In this regard, Detroit is just catching up to the import manufacturers who have been using the Bosch fuel-injection system for several years.

Here, Bendix, a big name among suppliers to the automakers and a leader in developing e.f.i., says it has signed contracts for 15,000 e.f.i.s for 1974 and looks for orders to jump tenfold to 150,000 units in 1975. "After that, e.f.i. will probably be standard equipment on most V8s in 1976," the company predicts.

Bendix doesn't resort to any weaseling in discussing its fuel injector. The company put the unit on a test car last year



PROGRAMMED COMBUSTION or "Proco" engine, as Ford calls it, uses fuel injection, a long sparkplug electrode and a specially shaped combustion chamber to get complete burning of fuel for low emissions



EMISSIONS MEASUREMENTS at Bendix laboratories are for unburned hydrocarbons, carbon monoxide, NO_x

and says it accomplished a feat the auto firms haven't been able to equal—meeting government clean-air standards for 1975. "By a comfortable margin," Bendix adds. (The test car carried other smog-control hardware in addition to e.f.i. The complete rig consisted of catalytic converter, exhaust recirculation system, special air pump and manifold reactors.)

About the same time e.f.i. begins to come in—maybe before—automobiles will have with catalytic converters. This device converts carbon monoxide and hydrocarbons into water and carbon dioxide.

GM is currently testing a fleet of cars equipped with catalytic converters in California. The cars carry different catalysts being evaluated by GM, most of them utilizing platinum and other noble metals. In addition to the catalytic converters, some cars have been equipped with electronic, high-energy ignition systems, super carburetors to provide precise fuel metering and an early fuel evaporation system to vaporize gas more completely in the manifold and reduce emissions during start-up. The plumbing gets pretty complicated. In addition to the new hang-ons, the test cars carry three additional emission control items standard on GM's '73 cars—exhaust gas recirculation, positive crankcase ventilation and evaporation emission control.

There are a couple of problems with the converters. You must use unleaded gas. If you don't the lead in gas coats the catalytic element and you put more gunk in

the air than you would with a current car. GM specifies the California test cars must run on unleaded gas.

Second problem: The catalyst is supposed to function troublefree for 25,000 miles. That's down from the 50,000 miles originally decreed by the government. The auto companies say they haven't even been able to come within a country mile of the lower figure thus far.

In their efforts to rehabilitate the i-c engine auto manufacturers have enlisted the aid of the petroleum industry. (Detroit hasn't been that pleasant about it, the refineries say. They accuse the auto companies of arm-twisting.) Automakers are



TEST CELL at GM Research Laboratory "road tests" engine, computer-duplicating actual road conditions

pushing the petroleum industry to innovate, to develop new types of fuel that will (1) put out less pollution and (2) provide more power from the same gallon.

Detroit claims it's trying to kill two birds with one stone. The petroleum companies say it's a case of the carmakers wanting their cake and eating it too.

Detroit wants new and better fuels for two reasons. First, it's concerned about car performance. The more pollution-control gear hung on a car, the more sluggish it becomes. Performance is degraded and you get fewer miles to the gallon. Second, the carbuilders say they'll have a better chance of meeting the tough 1975-76 pollution-control standards established by the government if the gas companies will

eliminate more hydrocarbons from fuel.

Petroleum products say if they take out the hydrocarbons, economy will decline—cars will use more gas. Detroit doesn't want that, so it's asking petroleum firms to change their formulas, develop new chemistry. The petroleum people say you can't get both white milk and chocolate out of the same cow without getting into some pretty expensive surgery.

One of the most knowledgeable men in Detroit on what can be done to clean up cars, Chrysler's Charles M. Heinen, says the surgery's going to run into millions, if not billions. Heinen, who developed the basic emission-control apparatus used on



FUEL INJECTION SYSTEMS meter fuel precisely. Here, electronic unit is shown installed in Bendix test car

all cars, says removing the lead from gasoline is only a first step. Any residue of lead left in the equipment used to store, transport and dispense gasoline could destroy the effectiveness of the catalytic element. This means that even if the petroleum companies change the "brew," the industry would have to start almost from scratch—design and build new gas pumps, new underground tanks at filling stations, new rail cars and trucks to carry unleaded gas, new storage tanks, new pipelines.

"The public, public officials and the environmentalist have yet to find out the magnitude of the task that remains," Heinen declares.

In their quest for improved fuels, auto firms have gone so far as to explore the

possibility of putting three spigots on the cow. GM has conducted tests using liquid petroleum gas (LPG), compressed natural gas (CNG) and regular out-of-the-pump gas in the same vehicle.

The results were a mixed bag. The cars operated on LPG and CNG did a good job reducing emissions. But fuel economy was cut 30 percent and there was a 38 percent loss in performance. "Unacceptable driveability compared with gasoline-powered cars," GM commented. To use a dual-fuel system—LPG and conventional gas—the car would have to carry an extra 50-pound container to hold the LPG.

In addition to the work Detroit's doing to save the i-c engine, the auto companies have been besieged with ideas from outsiders. While most suggestions are pipe dreams, a few ideas may have merit and the car firms are checking them out. The checkout list includes:

- *A pollution-control system developed by Questor Corp.* Questor claims its system surpasses government standards for 1976, doesn't require use of noble metals (palladium or platinum), will operate on leaded fuel, requires no major changes in the engine and does away with exhaust gas circulation.

- *An engine developed by International Materials Corp.* The IMC engine incorporates a device that's said to reduce gasoline to hydrocarbon and carbon dioxide. This nonpolluting combination, along with air, is then fed to the engine. IMC claims the engine will meet 1976 standards and can be used with leaded gas.

- *A hybrid eight-cylinder engine being worked up by Cornell University.* Six of the cylinders are internal to supply power, two cylinders are external to burn off pollution. Cornell says this configuration will eliminate pollution from carbon monoxide and hydrocarbons.

- *An engine developed by Honda Motor Co., Tokyo,* equipped with what Honda calls compound vortex controlled combustion. The engine has a small secondary combustion chamber at the top of each cylinder. This is capped by an intake valve. The sparkplug screws into the auxiliary chamber. The additional intake valve allows a rich fuel/air mixture to enter the auxiliary chamber. The regular intake valve brings an offsetting lean mixture into the main chamber. At the point

(Please turn to page 194)



FASTEST OFFSHORE speedster is runabout version of Don Aronow's 1972 world champion Cigarette racers



FINE FLAT HULLS of johnboats haven't gone out of style inland as this MonArk model with cabin shows



New for 1973 waterways

Speed, style and seaworthiness (most of the time) are the signs of the times for pleasure craft this year

By **BILL McKEOWN**, Boating Editor



STERN-DRIVE CRUISER from Reinell, largest builder of stern drives, also features new flybridge models

VACATIONER, 19-footer (above) from Cruisers, is a cuddy cabin and cockpit camper with canvas added

WRAPAROUND WINDSHIELD, popular styling feature, (left) is added attraction of a Scat-Craft runabout

OUTBOARDS now travel safely far offshore aboard the new fishing utilities like the S-22, Robalo and Pro-Line models shown at right. With high-enough freeboard to keep the water out and the anglers in, plus space for the crewmen to move around in the cockpit while battling gamefish, these models have the speed and seakindliness to make long passages



DECK BOATS are also growing up and this V-239 Sport Deck from Viking seats 12 and can top 35 mph



FISHING IN COMFORT is feature of new bass craft like Chrysler's 16-foot 1973 Professional Bass Boat

FIRST LOOK at this year's pleasure craft, and you might think you've seen them before. But there are improvements, changes and big new trends. PM's pick shows new popularity for everything from inflatables to flashy runabouts, speedsters with long curved windshields and boom-

ing bass boats with no windscreens at all.

Most boats are basically safe if used with the horsepower, weather conditions and number of passengers for which they were designed. But a wise choice is a bigger cruiser or utility for open water.

Look for more use of fiberglass. Fine





boats are being made out of aluminum, wood, other plastics and even new fabrics (in inflatables), but there are fewer craftsmen around to build wooden craft—and then give them the maintenance they require. Aluminum, ABS and other materials usually need more extensive manufacturing facilities. Good dependable hulls can now be well fabricated by established builders in fiberglass reinforced plastics, often referred to as FRP.

Note that your new boat should have a small plaque giving recommended horsepower and load-carrying capacity, as well as the builder's registration number. This year federal regulations require this, and



Silverline Aruba GTV



Uniflite Salty Pup



Checkmate



Sears Inflatable



Sidewinder XL

SILVERLINE's outboard and stern-drive Aruba GTVs come in 16 and 18-foot lengths using engines as big as a 260-hp jet

UNIFLITE has added this 23-foot trailerable fisherman to its extensive line of big boats

CHECKMATE flash is a result of performance plus a metallic glitter finish to the runabouts

SEARS is adding inflatables, like this one being tested by sports adviser Ted Williams, to its growing boat and motor line

SIDEWINDER offers one model of this open-foredeck runabout with a fiberglass deck covering

STARCRAFT adds high styling with new 24-foot flying bridge stern-drive-power cabin cruiser

MFG now has cat, sloops and catamaran rigs in its sailboat division. Dingo is a new 15-foot one-design, twin-hull addition



Starcraft Esprit 24

MFG Dingo



manufacturers and dealers must keep a record of purchasers in case any craft needs to be recalled to correct deficiencies. Dealers who install additional accessories may, in some cases, be considered a "manufacturer" and assume some of the new responsibility for correct workmanship. There is even a possibility that a dealer who might talk you into buying his over-size outboard for your undersize and underrated boat, might assume some responsibility if the overpowering of your hull results in failure of the boat. Final interpretation of the new laws is still being worked out, but it looks as if the boat buyer should benefit from the conscientious

work of established companies, as usual, and own a craft with serial numbers that may make it harder to steal and easier to recover.

A beneficial trend is a change in design in small craft above and below the water-line. Beamier tri-keel hulls, with assorted names like cathedral, tri-V multi-keel and rest, are offering a boat that is less likely to tip, although also less likely to ride smoothly sometimes in rough water. But the broadened bow allows an added cockpit forward of the windshield. Notice the many craft that are opening up the foredeck for seating.

Pontoon boats, deck boats and similar



Ouachita Convincer



Starcraft American

OUACHITA now has a line of six bass boats with UT model shown certified for 95 hp and 1750-lb. load. It's 16 feet long

STARCRAFT's extensive new line includes the 16-foot Open Bow American, outboard with cushioned deck seats forward

GLASTRON/CARLSON 21-footer CV model offers swivel forward seats, stern transom ladder, a wraparound shield, jet power

GLASTRON's Vagabond Camper-Cruiser V-215 sleeps five with camper curtains up. Hatch and bowrider foredeck are provided

CHRYSLER sport fisherman for offshore, the 20-foot Commando 300 is rated for outboards up to 180 hp, has 50-gal. gas tank

SYLVAN 824HT is a 28-footer with hardtop sundeck and diving platform. Rated for up to 85 hp, it could pull water skiers

FEBRUARY 1973



Glastron CV-21



Glastron Camper-Cruiser

Chrysler Commando 300



Sylvan Sundeck





Penn Yan Montego Cuddy

modern-day party rafts are also being improved. Cruising aboard them is now possible by pitching a tent or erecting an awning that can create privacy by mounting camper curtains. Boatmen and fishermen alike also like to come in out of the sun and rain, and now there are convertible navy tops, hardtops and even inventions like Penn Yan's dual-purpose pop-top that flips down from above the windshield to roof the cuddy cabin. Small cabins are popular. The cruiser with its big staterooms looks attractive at a boat show but may be less practical for fair-weather boating. Open utilities that provide plentiful cockpit space plus a small



Tri-Sonic Weekender



Aqua-Nymph



Mirro-Craft Ranger



Kayot Executive Cruiser



Duo Capitan

PENN YAN, of Tunnel-Drive fame, now has introduced an ingenious top that pivots down to cover the cuddy cabin of the Montego MR220 model

TRI-SONIC's deck cruiser, the Weekender 2200, is a 30-mph plush 22-footer that's offered with an optional galley

AQUA-NYPH, built by Aqua-Cycle, rides on two 10-foot pontoons in as little as 6 inches of water with 20 hp

MIRRO-CRAFT tops its line with the 17½-foot Ranger. The forward cuddy cabin can be locked. Craft will carry up to 1980 lbs. and use up to 145 hp

KAYOT calls its pontoon Executive Cruiser a 25-foot overnigher. This craft will sleep up to five aboard

DUO takes the cabin of its 1973 Capitan 20 trihull model and moves it forward to make use of foredeck

WELLCRAFT Weekender 24-footer has an Airlot hull, employs stern-drive power up to a dual 140, and comes with or without hardtop and galley

Wellcraft Weekender



cuddy cabin forward for overnighting or locking up gear, are a practical solution.

For today's boats, even small ones can do extended fishing and cruising. Bigger, better engines make long passages shorter, and additional advantages of the big boats—like flying bridges, twin engines, galleys, heads, and electronic gear—now make sense aboard a hull that can handle the open water that tempts today's skipper.

Craft we have already tested show added performance and safety features in many cases. Before buying, try your own test program by driving as many new models as possible. One should be best for you. ★★★



Chris-Craft Four-Sleeper



Glasspar Citation



MonArk Bass Boats

CHRIS-CRAFT introduces a new fiberglass 25-footer cabin model that's designed to sleep four and provides inboard power from a 200-hp engine

GLASSPAR outboard Citation is an open-foredeck 17-foot model that is designed for 2250 lbs. and 115 hp

MONARK displays its new Super Pro Ltd., Riviera IV, Mark II, Delta Target and Delta II bass boats (bottom to top)

SILVERLINE 18T Antigua converts from canvased camper sleeping four or more to an 18-foot open utility seating eight with a stern-drive rated to 165 hp

SEARS Gamefisher, of ABS plastic, is now available in 12 and 14-foot sizes. The flotation, as shown, tests out well

LARSON Baron, a trailable 21-footer, has deep-V hull, double bunks forward in cuddy cabin, 165 stern-drive power

REINELL is introducing a number of command bridge-station models like this 21-foot RV3240. Camper-back canvas can enclose cockpit for weekending aboard

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Silverline Antigua



Sears Gamefisher



Larson Baron



Reinell RV3240

Gadgets for better boating



THE EXTRA GEAR that goes aboard can cure a lot of problems afloat while making boating safer and more pleasant. Here's an early-

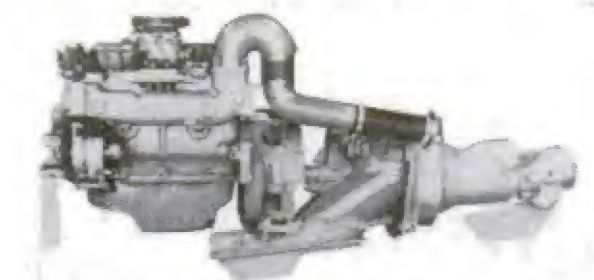
season selection of new items, plus older ones with new applications for boat owners. Engines are hardly accessories, but a number are being harnessed for new propulsion tricks. Others offer more power from smaller, lighter packages. Even sailboats are seeing new developments. ★★



KEEPING COMFORTABLE aboard, or afloat in water, is a new advantage of better designed life jackets like CG-approved Gentex Guardian



LIGHTWEIGHT POWER includes 235-cu.-in. engine—290 lbs. (427 with jet drive shown)—by American Challenger. Lighter yet: Cannon's Magnum ABS paddle



PULL on dashboard handle (top) opens transom trap to drain bilge of a boat traveling at speed or being trailed down the road. New \$20 Bilge Bailer from Northwest Marine is reported easy to install in any hull having a 1-inch drain tube

PUSH from a compact power package is advantage of latest OMC J-140 Jet Drive engine and pump unit. Four-cylinder inboard cranks 140 hp into water-jet impeller. Size is especially suitable for smaller hulls. Fin on jet nozzle improves lower-speed steering in forward, reverse. Angle of jet adjusts for top performance with trimming control to deflect engine and jet up, down



THERMOS has noted its Space Sportsman's Blanket will serve as warm-weather sunshade or wet-weather cockpit cover that folds compactly in tackle box



COMPASS-HATING SKIPPERS who would give anything to replace the spinning dial can now pay \$1150 for Helms-Mate computer with digits and course pointer



UNDERWATER AIDS include straight-line chart recorder, Model 470, from Ray Jefferson that draws distortion-free picture of bottom and fish. \$225

SST PROPELLERS of stainless steel and Teflon S (right) are five times as strong as aluminum, add up to 3 mph speed, according to OMC Accessories



SUPER BEACHER slides under a sailing surfboard or boat and rolls it to and from the water with little effort. Unit is \$40; Metadyne, Garfield Heights, Ohio
FEBRUARY 1973



CONVERSION TO SAIL for any rowboat or canoe is claimed for Michi-Craft's \$245 kit, with sail, spars, leeboards, rudder, motor-mount bracket



EXTINGUISHER SYSTEM for engine-compartment fires is FiQuench, a rechargeable automatic unit for owner installation. \$400, Pike Metal Products

AQUABUG'S SYSTEM 1
POWERS OUTBOARD WITH
GAS OR ELECTRICITY, OR
RECHARGES BATTERY



GASOLINE
POWERHEAD

COUPLER

6 OR 12-VOLT
BATTERY

OUTBOARD
LOWER UNIT

ELECTRIC
POWERHEAD

6 OR 12-VOLT
GENERATOR

This gas burner can go electric

SMALLER OUTBOARDS have been made, but probably none more versatile than Aquabug's new combo. Now the gasoline outboard has added options that can turn it into an electric trolling motor or a 6 or 12-volt gasoline-powered generator. Aquabug/System I is the name for this little three-way waterway act.

First came the 1.2-hp Aquabug gas outboard, an 8½-pounder with adjustable height bracket, anodized lower unit and self-lubricating Nylatron gears, all covered with an unconditional one-year guarantee. The new Aquabug electric uses the same type lower unit and claims protection from motor seal leaks by keeping the power unit above the water. Switches are reported to be both water and vaporproof. The electric retails for \$75.

Put them all together, however, add a coupler that mates the gas and electric power heads, and the result is a generator that can recharge your 6 or 12-volt storage battery or power accessories such as a bilge pump. Suggested uses include standby emergency lighting ashore or recharging boat batteries afloat.

As a package, System I weighs 14 pounds and costs \$175 complete. This will include the Aquabug gas powerhead, electric head, lower unit to fit either interchangeably, and converter to mate gas power head to the electric for generator use. All three options are available by mail from Seaborne Systems, 4413 Austin Blvd., Island Park, N.Y. 11558 and selected dealers. ★★ ★

POPULAR MECHANICS



ELECTRIC
POWER-
HEAD



GASOLINE
OUTBOARD

MULTIPURPOSE MOTOR can run on gas and electricity, swap power heads back and forth, or couple gasoline head to electric to become a 6 or 12-volt generator and run appliances or recharge a storage battery for trolling motor

Canoe cart



By **BOB HICKORY**

PORTAGING is a lot easier for paddlers with this handy canoe mule built to fit a hull bottom



YOUR CANOE OR BOAT can get around easily ashore with this carrier. You'll need a pair of bicycle wheels with tires and axles, two lengths of 1½-inch angle iron 52 inches long and four 38-inch lengths (old bed-frame iron will do); also two 38-inch pieces of 2x2 softwood, eight 1¼-inch wood screws and eight ¼x1-inch bolts with lock washers and nuts.

Pair the four pieces of 38-inch iron so that vertical surfaces are facing each other. Drill holes in dead center of the verticals

to accept axles. Mount axles and wheels. At each end of 52-inch cross members align wheel support pairs and drill ¼-inch holes to bolt them together. Don't be tempted to weld the joints since wheels cannot then be removed for possible tire repair. Drill four holes in horizontal surfaces of each 52-inch crosspiece and secure 2x2 lengths with screws from below. Notch 2x2s in center to fit canoe's keel.

Small marks on your hull can show how to load it for best balance. ★★★



LAUNCHING or hauling out can become one-man job



CART UNBOLTS for stowing in car trunk or aboard



KEEL NOTCHES in cross members help center the hull
FEBRUARY 1973



FOR SHORT TRIPS cart can ride on a cartoppper canoe

So you want to build your own



Should you or shouldn't you? Here an expert lists important pros and cons that you'll need to know.

By BOB WHITTIER



BIG SAILBOATS this size may take years but could then cruise you around world



BOLERO, a racy new 24-footer from Glen-L Marine with twin bunks forward, costs \$40 for full-sized plans, \$250 for frame kit

THE URGE TO BUILD your own boat is a strong one. Even with the wide assortment of factory-built pleasure craft on the market, many handsome and able boats are constructed every year by amateurs. But it's also true that do-it-yourselfers have produced floating monstrosities, after starting projects hastily and blindly. It is important to learn what you are about to undertake *before* you start.

Reasons for wanting to build your own boat are varied. For some it is a challenge for their skill with tools. Others do it because a specialized boat is not commercially available. Many hope the do-it-yourself route will save lots of money.

Let's be realistic about costs. There is no fixed rule for determining the final expense of a homemade boat. Be warned—sometimes you can save, but sometimes not. Much depends on the particular

boat's design, size, materials required, and whether you're starting from scratch, building a kit or finishing off a premolded hull. Modern boat factories buy material in carload lots at low prices and put it through very efficient production lines. If you buy all your components at retail prices and use your tediously erected building jig only once, the cost in dollars and time for your completed boat may be such that you'd be better off to buy a used boat—or a new one at an end-of-the-season reduced price.

To illustrate, materials for a well-made plywood rowboat would run to around \$100. An aluminum johnboat able to do much the same job can be bought for less! On the other hand, no company mass-produces certain types of craft, from fine round-bottom rowboats to heavily-built ketches suitable for ocean crossings. Hav-

POPULAR MECHANICS



PREPARATIONS for framing out may require space of a rented warehouse. Figure you'll start job upside down, then right the planked hull for final decking

Mich. 48072, for a sample copy of its magazine *Amateur Boat Builder* in which plans are advertised. Capt. Jim Orrell, Box 720, Galveston, Tex. 77550, has plans for dory-type boats of all sizes and styles. Or for \$1, a *Plan Kit Catalog* is available from Clark Craft, 16-P Aqua Lane, Tonawanda, N.Y. 14150.

When studying plan catalogs, remember some boats are designed to be built of traditional woods which may be hard to get. Maurice L. Condon Co., 252 Ferris Ave., White Plains, N.Y. 10603 has a 10-cent pamphlet, *How to Select the Right Boat Lumber*. Harbor Sales Co., 1409 Russel Rd., Baltimore, Md. 21230 also stocks marine plywoods of all common domestic and imported types.

Boats of common lumberyard wood should be copiously treated with antirot preservatives. Write to Forest Products Laboratory, Madison, Wis. 53700 for its pamphlet, *Decay of Wood in Boats*. And a source of information on painting is the pamphlet, *Boat Paintenance*, available for 50 cents from the Baltimore Cooper Paint

Co., 501 Key Hwy., Baltimore, Md. 21230.

Purchasing various specialized materials can be simplified by building from a kit. Though there are fewer kit suppliers than a number of years ago, excellent kits are still available. Luger Marine, 3800 West Highway 13, Burnsville, Minn. 55378, sells fiberglass boats in kit form and has a free catalog. These kits consist of port and starboard hull halves plus other fiberglass moldings nested for crating, and the builder fastens these together with usual fiberglass techniques. Glen-L also offers frame kits that can get the amateur over the hurdles of obtaining material and erecting accurate frames. Sheet plywood is bulky to ship and suitable kinds are often available from plywood warehouses through local lumber dealers. As a result, frame kits are easier and cheaper to ship. Kits for additional kayaks, canoes and sailboats can be found in the classified section of this magazine each month.

So-called ferro-cement boats are becoming more common in the amateur

boatbuilding field. The process is basically simple, but study is necessary to learn how to do it properly. This material is considered too heavy for fast planing boats in the small powerboat category. As size increases, however, ferro-cement compares more favorably with other materials because the numerous internal frames and stringers that add weight to large wooden craft are not needed. Home-made fiberglass boats can also be built from scratch after an amateur has carefully studied the specialized techniques.

To begin learning about fiberglass and ferro-cement, send \$2.50 to International Marine Publishing Co., 21 Elm St., Camden, Me. 04843, for a copy of *Reprint on the Use of Ferro-Cement in Boatbuilding*, and \$3 for *Reprint on the Use of Plastics in Boatbuilding*. Ask them to also enclose a copy of their useful boat book catalog with your order. Bare fiberglass hulls of inboard powerboats and sailboats that can be finished off by the buyer are now available from some firms. Many advertise in the monthly trade paper, *National Fisherman*, at the same address above in Camden. A sample copy is 50 cents, and the paper carries many boatbuilding articles.

Building a boat differs from other kinds of carpentry in that so many pieces of wood must be curved and beveled. One way to get the knack is to construct a small boat before attempting a more ambitious one. Good boatbuilding books describe such specialized tasks as drawing full-size hull lines, steaming ribs, spiling the planking, caulking seams and plugging screwheads—all techniques that some beginners seem to expect to find described on the set of plans they buy.

Libraries, book stores and International

Marine mentioned above are a few of the sources for good books. Also write to Sailing Book Service, 34 Oak Ave., Tuckahoe, N.Y. 10707, and to Boatman's Bookstore, 21 West 46th St., New York, N.Y. 10036. Describe the kind of boat you want to build and what you need to learn about boat-building. Ask them to suggest appropriate books. Also look up mail-order firms that supply building supplies in *Boat Owners Buyers Guide*. Then order a few of the \$1 catalogs. Each will contain listings for all sorts of hardware, compounds, tools and accessories. Leafing through them is a liberal, and very pleasant, education in boat fittings and gear.

And now there is something else you will need to know. It appears that many homemade boats are going to have to comply with design and equipment requirements currently being formulated by the Coast Guard under the Safe Boating Act of 1971. Ask a local boat yard or your post office for the address of the district Coast Guard headquarters nearest you, and contact the Coast Guard for up-to-date advice on how new requirements might apply to your boat. If building a larger boat, send \$10 to American Boat & Yacht Council, 15 East 26th St., New York, N.Y. 10010, for *Safety Standards for Small Craft*.

And finally, save sales slips when buying materials. They will be useful in proving ownership and meeting sales tax requirements when registering your completed boat. If it's large enough to be insured, ask your insurance company to send a man around to look at it early in the project. That way you can prevent unforeseen red tape from making it difficult or impossible to insure your pride and joy dreamboat when it's finished. ★ ★ ★

BOATBUILDERS' REFERENCE GUIDE

AMERICAN BOAT & YACHT COUNCIL, 15 East 26 St., New York, N.Y. 10010

AMERICAN PLYWOOD ASSN., 1119 A St., Tacoma, Wash. 98401

BOAT OWNERS BUYERS GUIDE, Dept. PM, 50 West 44 St., New York, N.Y. 10036

BOATMAN'S BOOKSTORE, 21 West 46 St., New York, N.Y. 10036

CLARK CRAFT, 16-P Aqua Lane, Tonawanda, N.Y. 14150

MAURICE L. CONDON CO., 252 Ferris Ave., White Plains, N.Y. 10603

FOREST PRODUCTS LABORATORIES, Madison, Wis.

GLEN L MARINE, 9152 Rosecrans Ave., Bellflower, Calif. 90706

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HARBOR SALES CO., 1409 Russel Rd., Baltimore, Md. 21230

INTERNATIONAL AMATEUR BOAT BUILDING SOCIETY, 3183 Merrill, Royal Oak, Mich. 48072

INTERNATIONAL MARINE PUBLISHING CO., 21 Elm St., Camden, Me. 04843

LUGER MARINE, 3800 West Highway 13, Burnsville, Minn. 55378

MOTOR BOATING & SAILING BOOKS, Box 2316, New York, N.Y. 10019

NATIONAL FISHERMAN, 21 Elm St., Camden, Me. 04843

CAPT. JIM ORRELL, Box 720, Galveston, Tex. 77550

POPULAR MECHANICS SERVICE BUREAU, 224 West 57 St., New York, N.Y. 10019

SAILING BOOK SERVICE, 34 Oak Ave., Tuckahoe, N.Y. 10707



Boat that floats no matter what

It would be easy to play odd couple afloat in Shakespeare's new WonderCraft 12 with flotation to spare

By BILL McKEOWN, Boating Editor



SPLIT PERSONALITY is possible, though not normal condition, of this foam-strengthened ABS plastic hull

IT'S PLASTIC—but not fiberglass. It's not a "bass boat"—but could catch plenty. It can mount motors at both ends, carry three passengers and 15 horsepower easily, and even if swamped, you'd need to make an effort to sink it. Built-in flotation keeps the rig afloat even when level full of water and with passengers, gas and electric kickers, gas tank, battery and gear aboard. You'd probably need a load of 600-plus-plenty pounds of lead sinkers to get this new little model to go down.

Shakespeare, long famed for fishing tackle, archery gear, depth and fish finders and electric fishing motors, has now gone into the boat business with a neat 12-

foot tri-V-hulled utility. It's called a WonderCraft 12, probably in honor of its many features plus just possibly because there are already WonderTroll electric fishing motors, Wonderods, Wonderpoles, and Wondercast reels using Wonderline from Shakespeare's sporting-goods division.

We went to Washington, N.C., for a sneak advance look at how they put this novel newcomer together, and then a chance to run the rig for a performance check. Seacrest Marine builds the boat to specifications from Shakespeare's new boat division (Box 242, Columbia, S.C.). Requirements included a slick-finished hull that could be turned out in quantity and still have high quality control. Seacrest also makes the well-regarded Gamefishers for Sears, Roebuck out of ABS Cycloc thermoplastic, and Shakespeare decided on the same process for its design.

Inner and outer hulls are heat-formed



BOTH GAS AND ELECTRIC MOTORS can be mounted same time on transom; (both even ran submerged)

POPULAR MECHANICS

from the plastic sheeting in one of the most modern computerized and instrumented plants in the business. Cockpit and outer hull, when mated, are foam-filled under pressure to become a solid unit of notable strength with good ability to float.

How good? Years ago Boston Whaler may have been the first to cut its boat in half on purpose, though since then a number of companies have claimed similar tests. It seemed a shame to saw up a handsome new WonderCraft, but it also was a sure way to put a small boat's flotation on the line. Out from shore on the Pamlico River two brave Seacrestmen sawed away until bow and stern sections parted and floated free. Now the good stability of the hull was lost and the little WonderTroll motors dipped occasionally underwater, but without shorting out.

Fine—but who's going to chop up his boat? The next experiment was almost more impressive. A boat was flooded and a trusty little 9½-hp Evinrude on the stern started up. Gunning it caused the bow to rise and momentarily submerge the Evinrude completely, but it never quit! As speed increased water spilled out, and a fisherman who'd caught a wave aboard could have bailed and run the boat dry without capsizing.

Testing over a chop, we found the boat handled well for the size, and timed runs report 20 mph from 10 hp. A lot of inshore fisherman should take to this one, and look forward to additions to the new line. ★ ★ ★



CENTER STORAGE COMPARTMENTS also divide hull with water barriers, and can serve as fish-bait wells



MOTOR MOUNTS are molded into bow (background) and stern. Plugs allow draining center compartments



TWO FOR THE PRICE OF ONE, but with limited free-board, is result of cut-up test of hull's flotation
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STOWAGE BOXES in bow and under center seat have seat tops secured with shock cord to prevent loss



Hoist your hull on air



INSTALLED in slip, hoist unit is completely submerged and only hoses to blower pump can be seen



AIR DISPLACES WATER in twin fiberglass tanks and boat bow rises first on padded cradle of the hoist

By PENNY NICOLAI

DRY DOCKING is no longer only for big ships. An Oklahoma outfit has developed a fiberglass tank system that can become an aquatic elevator for the family runabout.

Drive into a slip rigged with a Hydro-Hoist and only a pair of small hoses running up to a pump box on the dock will hint at the clever gadgetry waiting underwater. A water depth of 3½ feet is required; more is needed for keel sailboats.

Two 16-foot fiberglass tanks lift a framework which mounts supporting pads for the boat, and the unit slides up and down on brackets clamped to the dock. Installation takes about 2½ hours. Air pumped into the tanks from a dockside blower does the work and there is no strain on the dock. Width of the slip needs to be between 7 and 12 feet. The two-stage blower requires 110-volt a.c. current and a 12-volt d.c. model is being developed. Units for 2000, 4000, 6000 and 8000-pound boats are available. The 2000-pound hoist shown costs \$970 installed, plus shipping charges from nearest dealer.

After driving into his slip, a boatman can switch on the blower while still aboard if the control is mounted nearby. First bow and then stern are lifted above the water, clear of summer fouling or winter ice. Lowering the boat is equally simple.

For details, write Hydro Hoist Co., 820 West 10 St., Claremore, Okla. 74017. ★ ★ ★



LIFTED CLEAR OF WATER, fouling and ice, the hull is stable enough for passengers to climb aboard



HOIST GUIDES on each side slide up, down in dock brackets. Installation takes less than three hours

For cartopping— here's the catch



By MARK SOSIN



SECURE without a spiderweb of tie-down lines, this cartopper is held in place with ropes to clips under hood and trunk-lid edges

TIE-DOWNS, TOO OFTEN, are a tangle of ropes that have been woven in a spider web over and around a cartop boat or other over-size gear on the roof. Then they come down and through windows and around door handles and bumpers in an attempt to keep the boat or luggage from shifting forward and aft or side to side while traveling down the road. Sometimes the rigging is so extensive that doors, hood or trunk of the car can't be opened until the launching ramp is reached. Checking the oil, unloading a spare tire or even getting out for a stretch presents a problem.

But Les Hodax of New Shrewsbury, N.J., worked out this simple solution. He fashioned light-gauge metal clips, as shown, that seat in the joint between car hood and fenders and in the recesses at either side of the trunk lid. A rectangular opening is cut in each catch to hold a premeasured line knotted to it. Position catches, close hood and trunk and the boat is secured. Open them for instant release. ★★



METAL CATCH is bent to fit hood or trunk lip. Opening in catch is cut and bent to prevent slicing rope



TIE-DOWN ROPE is measured for tight fit, permanently knotted to cutout in clip for bow, stern lines

ENGINE SERVICING is a cinch since neither metal catches nor tie lines need to be removed now when raising hood for checking water and oil



TRUNK ACCESS is even more convenient. With no tie-downs knotted to the trunk handle or rear bumper, gear can be unloaded at any time without un-lashing the cartopper. Tension on transom of boat remains the same each time trunk lid is closed with rope clips in place



Short course in antennas for shortwave listening

By FOREST BELT

THERE'S A LOT to listen to on shortwave: musical programs you can't get on regular radio, ham talk, the drama of police, fire and aircraft calls, and news and propaganda with unusual foreign slants (including our own Voice of America broadcasts). Shortwave radios are available in all price ranges. But none of them can do a good job without a good antenna.

Sometimes that's just a wire hung across the yard (but a precisely cut wire—see next page). Or it might be a fancy-looking gadget on a rooftop mast. Your choice depends on what you want to listen to.

Frequency and wavelengths

A long piece of wire picks up certain stations well, but a shorter version suits others better. Indeed, a 16-inch wire works best for most police, fire and ambulance broadcasts.

Why? The reason involves *frequency*, *wavelength* and *resonance*. If you're a shortwave or even a hi-fi fan, you may already know what those terms mean.

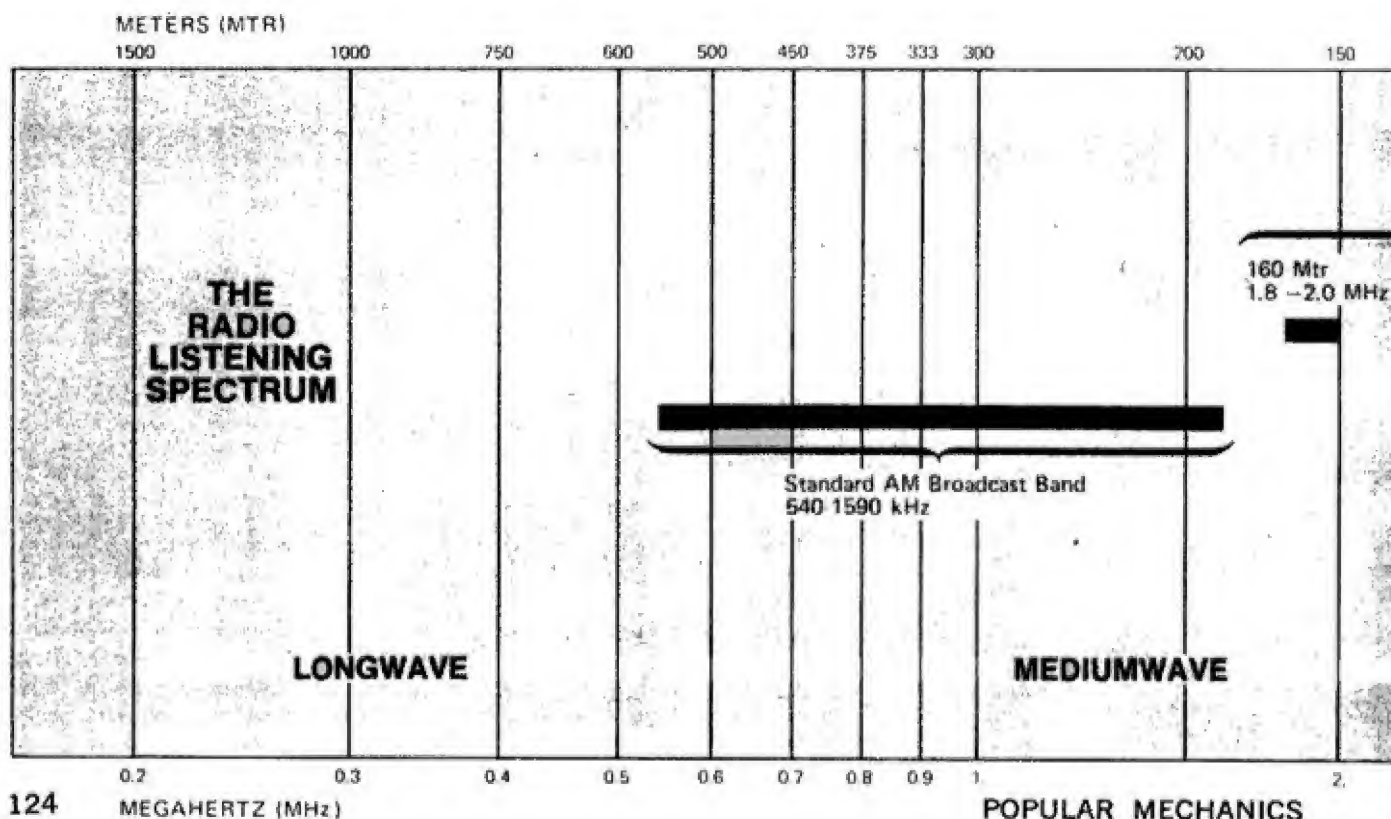
Frequency is marked on the dials of

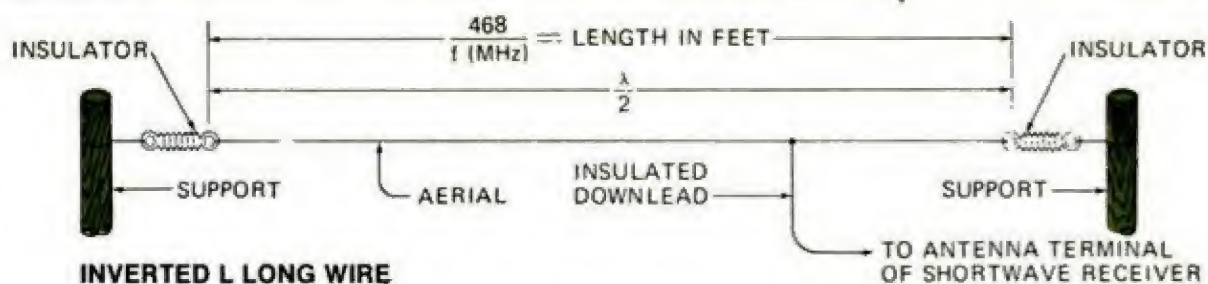
radios. On older sets, they're in kilocycles (KC) or megacycles (MC), which stand respectively for thousands of cycles per second and millions of cycles per second. Many recent radios have the modern equivalents: *kilohertz* (kHz) and *megahertz* (MHz). A megahertz (1 MHz) equals a thousand kilohertz (1000 kHz).

Radio stations everywhere operate on their own assigned frequencies. When you "tune in" a station, you're actually setting special circuits inside the radio to *resonate* at the station's frequency. They let you make your receiver sensitive to that one frequency and no other.

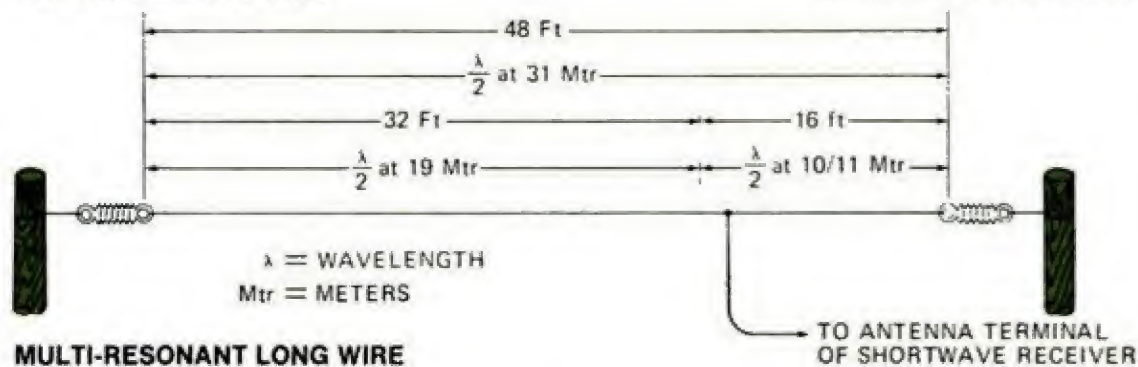
Wavelength is just what its name suggests: the length of the radio wave a station transmits, expressed in meters. The higher a station's frequency, the shorter its wavelength. To calculate the wavelength for any station, just divide 300 million (a radio wave's velocity in meters per second) by its frequency in hertz (the number of waves broadcast per second).

For example, if your favorite station operates at 15 MHz (15 million hertz), divide 300 million by 15 million. The an-





INVERTED L LONG WIRE



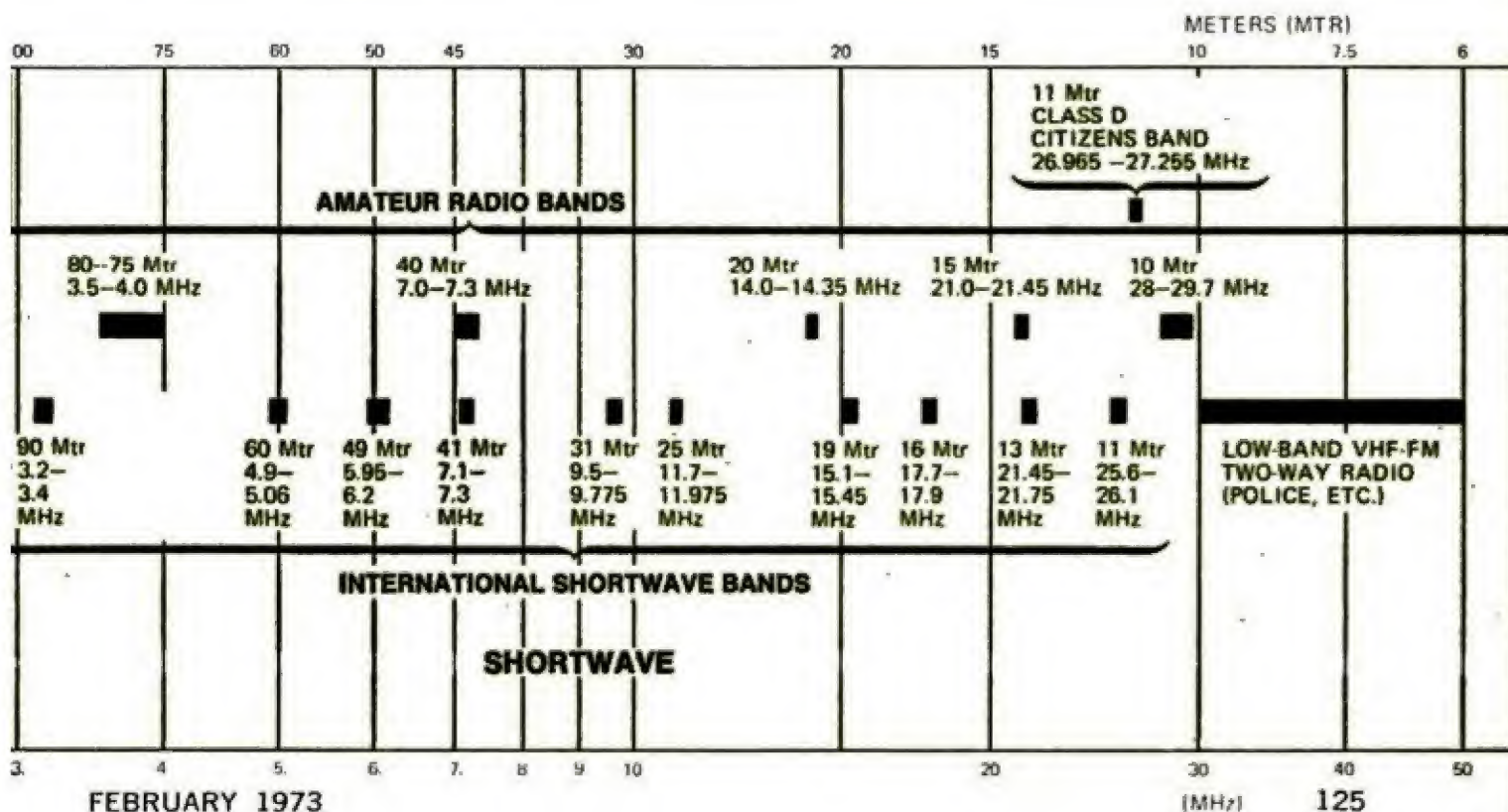
MULTI-RESONANT LONG WIRE



ANTENNA KITS have all materials needed for long-wire antennas. This Calctra kit costs \$2.75



ALLIGATOR CLIP is a good temporary connection to set. Plain wire or spade lug is more permanent



swer is 20, so the station's wavelength is 20 meters.

To calculate the wavelength of a broadcast station operating at 750 kHz, divide 300 million by 750,000 (or 0.75 million); this station's wavelength is 400 meters. The chart on page 125 graphically illustrates the relationship between megahertz (frequency) and meters (wavelength).

Antennas and half-waves

A radio signal is an electromagnetic wave traveling through the air. When a radio signal encounters any metal object, the forces in the wave set up corresponding "pulsations" in the metal. The more closely the object's size matches the signal's wavelength, the more strongly these pulsations are induced. The metallic antenna is *resonant*—or tuned—to that radio wave.

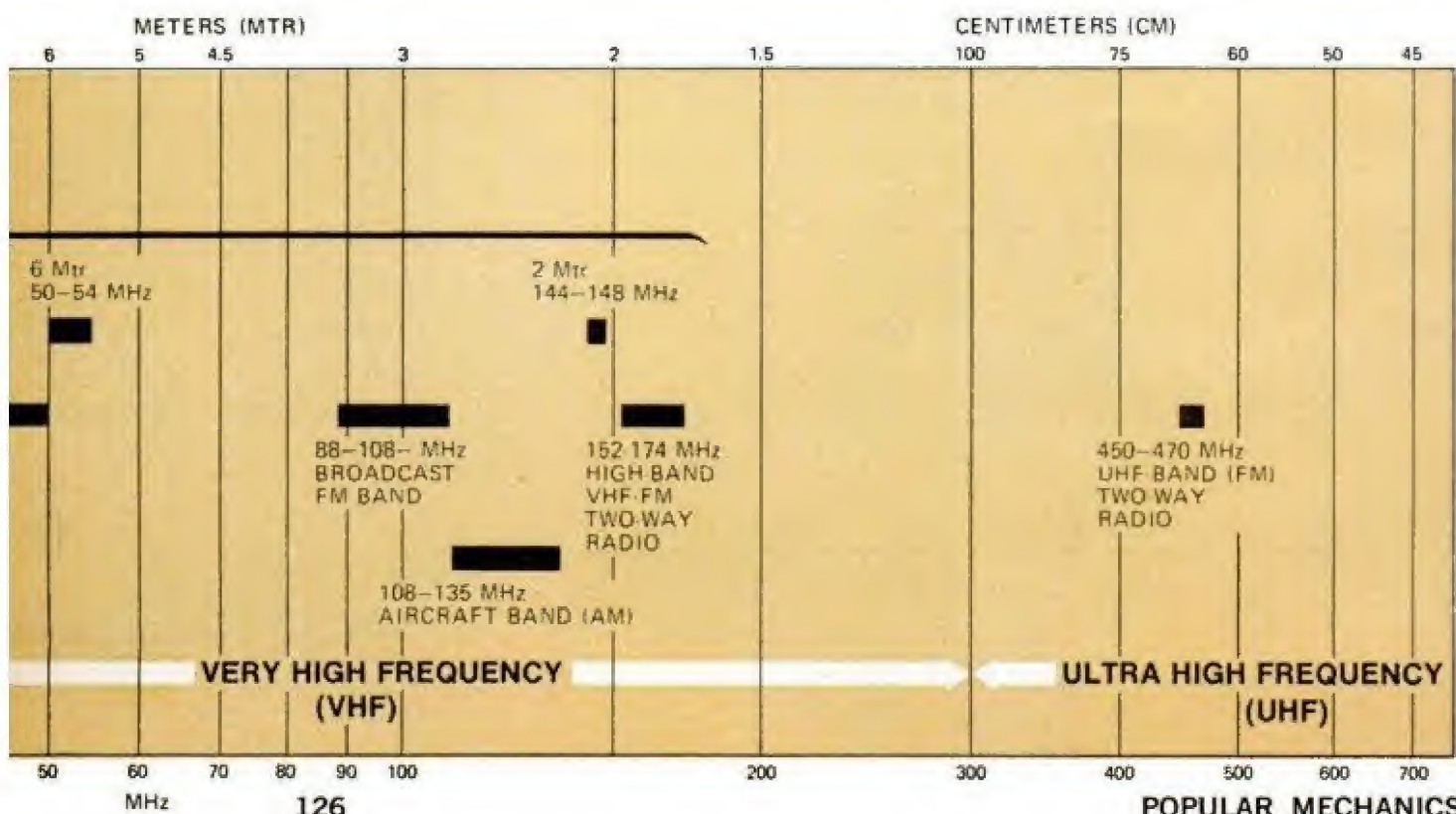
You can cut a metal rod or wire to a length that resonates at whatever frequency you wish; then you feed the induced radio signal down another wire to your receiver. The resonant rod or wire is the *aerial* part of your antenna, and the feed wire is the *downlead*.

Simple shortwave antennas come in two types: *long-wire* and *vertical*. For stations below 25 MHz, the long-wire seems most practical, and easiest to construct. Above 25 MHz, verticals are feasible; but you'll probably buy one ready-made rather than build your own.

The aerial portion of a long-wire antenna works mainly on a half-wave theory. That is, you make it half as long as the wavelength it should pick up. (The earth beneath the aerial "reflects" the other half-wavelength.)

The simple "inverted-L" shown on the preceding page installs easily. You need two insulators, a length of sturdy wire and a downlead wire. The kit shown with the antenna sketch has bare aerial wire, stranded for strength, and a downlead that's insulated so it won't be accidentally shorted or grounded out. Two standoff knobs support the downlead, and a flat insulated strip passes it under the window sash.

How long should the aerial be? That depends on what you listen to. Suppose you listen a lot to overseas broadcasts from Great Britain on a frequency of 6110 kHz (same as 6.11 MHz). Wavelength of that station (300,000,000 divided by 6,110,000) is 49.1 meters. A half-wavelength is 24.55 meters. Actually, a long-wire antenna should only be 0.95 times as long as this, due to capacitance of its end insulators, so your net length would be 23½ meters, or 76.5 feet (a meter equals 39.37 inches, or 3.28 feet). If you want to calculate the wire's length in feet directly, there's an even simpler way: just divide 467.5 by the station frequency in megahertz, and you get the aerial length in feet. (In this example, 467.5 divided by the





GROUND-PLANE antenna's horizontal rods serve as reflectors



LOADING COIL in middle of whip electrically "extends" its length



MINIATURE WHIP is quarter-wave aerial for 450-470 MHz 2-way FM



TRUNK-EDGE CLIP mounts mobile antenna without drilling the body



PL-259 PLUG is commonest for CB and other coaxial antenna leads



HIGH-GAIN antenna can be costly. This Avanti Moonraker is \$130

6.11 MHz frequency is about 76.5 feet.)

The inverted-L works well both at *and near* its resonant frequency, so the 76-footer is effective for any frequency in the 49-meter shortwave band. But the antenna is sensitive at multiples, too: The wire tunes two half-wavelengths near 12 MHz, the 25-meter shortwave band, and stations near 18 MHz (the 16-meter band) resonate the wire at three half-wavelengths.

Connecting the download at a point other than the end may suit a similar purpose. An accompanying sketch shows a wire cut for the 31-meter band, about 9.6 MHz (with a 48-foot, 15.5-meter half-wave). The full length also makes two half-wavelengths for 15 meters. Connecting the download 16 feet from the end helps the aerial "divide up." The short section operates on a half-wavelength

near 10 (and 11) meters, and the longer one resonates close to 19 meters.

However, exact aerial length is not always necessary. With many shortwave radios tuning frequencies below 25 or 30 MHz, you can use any reasonable length of long-wire antenna, because they include *trimmer* knobs that tune the antenna electronically. Your receiver instruction book tells what lengths of aerial will suffice. If you only have room for a short wire, or perhaps a telescoping rod, you can add a *loading coil* that makes the antenna electrically longer. The coil compresses some antenna length into a smaller space.

Quarter-wave verticals

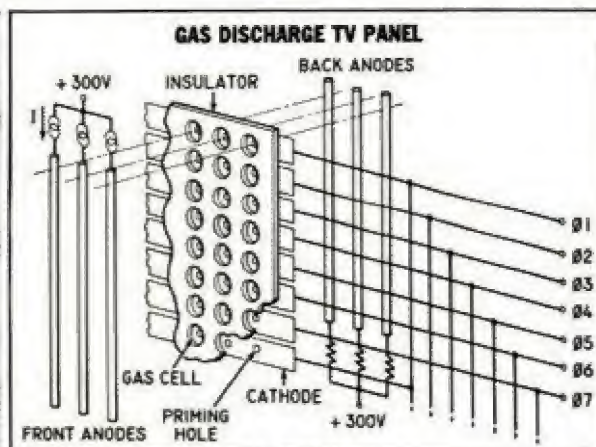
Most shortwave receiving antennas would work better upright instead of

(Please turn to page 194)

IT'S NEW NOW



Latest in flat-screen TV is only 0.63 inches thick, lights with neon



Next to the television set at far left is a screen that matches its contrast and resolution, but is only $\frac{5}{8}$ inch thick (see side view, near left). The new panel has the same dot-spacing (shown full size, lower far left) as a 25-inch TV screen, but is only 5 percent as large (full-size screen has been masked off to match it). Though bright enough for viewing in normally lighted rooms, it's dimmer than conventional tubes, glows red instead of white. Developed by Burroughs and adapted for experimental TV use by Zenith, it uses cells filled with neon gas instead of conventional tube's phosphor dots. Cells light at intersection of charged cathodes and anodes.

Go to blazes, they said, and this fire truck does—any way it can get there

Taking a shortcut up some steps and across a park is this mini fire engine's way of getting to fires quickly without bogging down in traffic jams on main city streets. The Swiss-made truck, currently under test by London's Fire Brigade in England, is deliberately designed to be short and narrow so it can race down side roads, cut through back alleys, squeeze between buildings and turn sharp corners without having to use heavily traveled routes. Special low reduction gearing and a powerful engine enable the vehicle to climb steep grades—up to 45 percent. Equipment includes ladders, a variety of fire-fighting gear, emergency breathing apparatus and two-way radio. Mini or not, the tiny engine holds a crew of four—and they don't have to hang on outside, either.



THE LATEST PRODUCTS AND DEVELOPMENTS



Laser sight sharpens repairman's aim

Straightening an accident-damaged car chassis is tricky because it's difficult to tell when a twisted frame has been properly realigned. Now the Swedish firm of AGA in Stockholm has come up with a laser-operated sighting device that makes it possible to check frame alignment to within a fraction of an inch, using the beam as a super-accurate "yardstick" to measure with.



Soft-faced mallet for a soft touch

You get four screw-in rubber heads for this versatile soft-faced mallet. Shapes include flat, dome, cone and wedge. Three weights are 14 ounces, \$5.99; 1½ pounds, \$6.99; and 3 pounds, \$9.49, all postpaid. Creative Educational Services, Box 663, West Caldwell, N. J. 07006.

FEBRUARY 1973



Hybrid forklift/tractor does many jobs in one

This all-purpose industrial machine not only functions as a regular forklift (bottom above), but takes a variety of attachments for handling barrels and other odd-shaped loads (top). With lift removed, it becomes a tractor for hauling carts, plowing snow and doing other plant chores. To top it off, GE Elect-Trak runs entirely on battery power.



TV chair entertains you while you wait, but you better have some coins ready to feed it or you'll get only a blank screen

Novel TV lounge chair at left sports a small, coin-operated television set mounted on an outboard arm so you can while away the time watching your favorite programs during long waits. The manufacturer plans to install the chairs in laundry centers, beauty parlors, airport waiting rooms, hotel lobbies, doctor's offices and other public places where you spend a lot of time doing nothing. They can also be used in schools to bring students educational programs over closed-circuit TV. Not yet announced are chair's price or how many coins it will take to keep you happily occupied. Whisper Aire Corp., 11847 Levan St., Livonia, Mich. 48150. Now if they'd just put one in a dentist's chair . . .

Anyone can now hone a chisel or plane iron like an expert

You can hone a true, square edge on plane irons and chisels the very first time with this clever fixture that holds the cutter at the proper angle as you roll it back and forth over the stone with a figure-8 motion. The accessory accepts blades up to 2½ in. wide. You can get one for \$3.55 plus postage from Brookstone Co., Peterborough, N.H. 03458.



Lose your golf ball? Just follow its beeps and you'll find it

A tiny transmitter inside this new golf ball sends out beep signals picked up by a pocket receiver you carry with you. If you land in the rough, the ball is easily found by following the beeps as they become louder and louder. A British invention, the "talking" ball is not yet on sale.



Electric impact tool does work of air-driven one

Double-insulated for greater safety, Sears' new square-drive impact tool can perform jobs done by air-driven models. Heavy-duty, 1/3-hp motor operates on forward or reverse with ball and roller-bearing drive. Features adjustable torque and speed trigger. About \$80.



Fingers too big? Use these long-nose tweezers

Anything hard to reach is easy to get at with these giant (10-in.-long) stainless-steel tweezers. Indispensable for chassis and other intricate assembly work, they have slender tips with rounded ends and serrations for a sure grip. \$4.85. Brookstone Co., Peterborough, N.H. 03458.



Speeding? Well, at least you can't say they didn't warn you

If you get a speeding ticket after going through this maze of warnings, you have only yourself to blame. In addition to prominently posted speed-limit signs, a big radar-controlled speedometer-like dial shows your exact speed as you approach. Los Angeles police, testing the device, report it really impresses the motorists.



Nonstop toll-taker speeds bridge traffic

Cars crossing San Francisco's Golden Gate Bridge may no longer have to stop to pay a toll—they'll just roll over an electronic detector and be billed later by mail. To identify itself, each car is fitted with a device underneath (above) that reflects a keyed signal back to the detector. The system is designed for regular bridge users such as buses and commuting drivers.



Computer and laser make paint-by-number personal paintings from favorite photos



If the only way you can paint is "by the numbers," you no longer need restrict yourself to landscapes, clowns and flowers. Now you can paint your own family (or any other subject of your choice) that way. In a new process, a computer analyzes any color photo or slide, then a laser prints it as a series of numbered color zones on 16x20-inch paper. The computer also determines which 40 or so of 100 available colors are needed and packs them with the picture, instructions, brushes and practice panel. "Personal Paintings" are \$19.95 from Craft Master Div., General Mills, Box 123, Toledo, Ohio 43695. Delivery takes three weeks. Itek developed the "Chroma-Guide" process.

Quickie kit-built R/C sailplane

It's big, but easy to build. This powered, radio-controlled AS K14 model has a whopping 90½-inch wingspan and fully operating control surfaces. \$159.98. General Hobbies, Philadelphia.



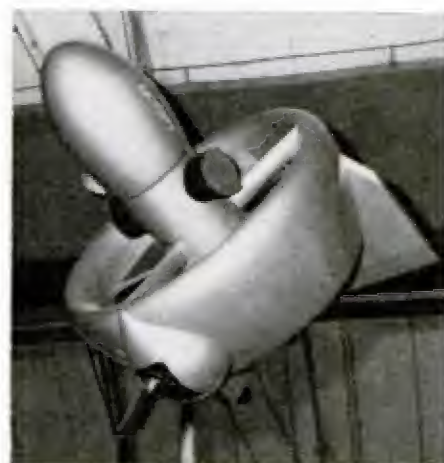
It may scare you stiff, but it will take you anywhere

Riders cringe in terror as this strange contraption plunges over a cliff edge to apparent destruction. Actually, it's so completely articulated it can cling to and climb over virtually any terrain. Each wheel moves up and down independently, and swivel-linked front and rear sections can be hydraulically "jackknifed" to straddle ridges and gullies. Inventor Ken Waller of Miranda, Calif., hopes to find forestry and military uses.



Jet-propelled swimming: Just hang on and away you go

If you like your swimming both fast and lazy, this jet-powered Swimbobile will pull you along at speeds up to 15 mph—all you do is hang on. A 5-hp engine drives twin jet pumps, eliminates hazardous prop. \$329.50. Hammacher Schlemmer, 147 East 57th St., New York.



TV eye spies in the sky

Almost literally an eye in the sky, this pilotless hovercraft can "park" over a battlefield, send back television pictures of enemy activity. The British-developed "Skyspy," only three feet wide, is virtually invisible to enemy ground gunners.



3-in-1 tubing cutter works in tight places

Made of hardened and tempered tool steel, this handy tool not only cuts tubing and reams it, but its handle serves as a wrench to loosen the valve on all standard propane-gas cylinders. Three cutting wheels will cut aluminum, copper, brass and plastic tubing from $\frac{3}{16}$ to $\frac{5}{8}$ in. o.d.. For convenience, the tool requires only 120° turns to cut tubing in tight spots. Sells for \$4.98 from Kastar, Inc., Bellport, N.Y.



The first hers and his tool set

Women aren't supposed to know the difference between a jigsaw and a coping saw. But these days a lot of them do, so X-acto has created two new tool sets designed to appeal to a woman as well as a man. Each kit, (one for \$18.75, deluxe type for \$27.50) comes in finished tray that can sit in drawer. X-acto, 48-31 Van Dam St., Long Island City, N.Y. 11101.



Combination seat belt and air bag protects you two ways—if one doesn't work, the other may

This inflatable seat belt not only restrains you in the conventional way (far left), but it blows up in a crash (near left) to provide the added protection of shock-absorbing cushioning. Under development by Allied Chemical Corp., the double-duty device is designed to combine the best features of seat belts and air bags. Belt inflates instantly on impact by an inertia-triggered compressed-air cartridge.

If it sticks, slips, squeaks or shorts, Kure-Kit will take care of it

Packaged in a handy carrying case, four spray cans provide you with silicone lubricant, belt dressing, moisture repellent and penetrating oil. The moisture repellent produces a waterproof film barrier, the belt dressing dries clear, the penetrating oil cleans as it penetrates, the silicone lubricant makes anything slide easier. Price: \$5.80 postpaid, L.H. Shingle Co., 1300 Walnut St., Camden, N.J. 08103.



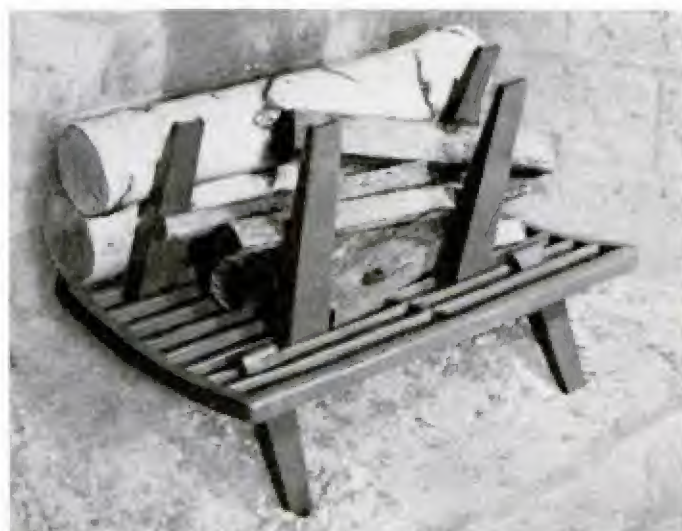
Air pump takes the huff and puff out of blowing things up—and down

Specially designed for low-pressure inflatables such as air mattresses, wading pools, beach toys and furniture, the Goodwin air pump and exhaustor has a regulated compression valve to prevent overinflation. Powerful 12-volt motor plugs in any car or boat cigaret-lighter socket, comes with 10-ft. cord, lighter plug, on-off switch, two plastic nozzles. \$9.95 postpaid from Glen-Bel Enterprises, Dept. PM, Route 5, Crossville, Tenn. 38555.



New computer-controlled rapid-transit monorail system practically thinks for itself

If you think you've seen 'em all, here's a monorail with a few surprises. Developed by the German firm of Siemens in Munich, it consists of small passenger pods whizzing along an overhead track completely controlled by computer. The computer automatically switches pods to different destinations, adds cars as traffic demands them. You just tell the computer where you want to go and it will get you there.



New-type fireplace grate cures most smoking problems

Adjustable log supports in this unique grate let you build fires far to rear of your fireplace where there's better draft, greatly reducing smoldering and smoking. Logs can't roll out. \$25. Garden Way Research Associates, Box W-116, Charlotte, Vt. 05445.

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Take-it-with-you burglar alarm

You can carry this portable battery burglar alarm with you for use on any door. Wedged underneath, it jams the door from opening, also sounds a high-pitched warning beep. \$5.95. Mallory Battery Co., Tarrytown, N.Y.



Pocket level stays put

Stanley's new 7-in. torpedo level has a magnet along one edge to hold it to any flat steel surface and a V-groove along the other to make it stay put on water and electrical pipes. Has replaceable vials; \$4.15.



Four aids to protect your home

Four new home security systems are especially designed by Magnavox for do-it-yourself installation. There are two sensor types for guarding doors and windows, electronic motion detector, and fire and smoke alarm.

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NOW



**If this is just a sample,
watch out for the real thing!**

Powered by a linear motor, the sleek rail car above is a 1/8-scale prototype of a new high-speed Japanese transportation system. In effect, the rails are the motor's "stator" and the moving car the "rotor." The model is 23 feet long and has hit 40 mph in tests. At this rate, the full-size version will be 115 feet long and may reach 200 mph!



Hibachi for all seasons

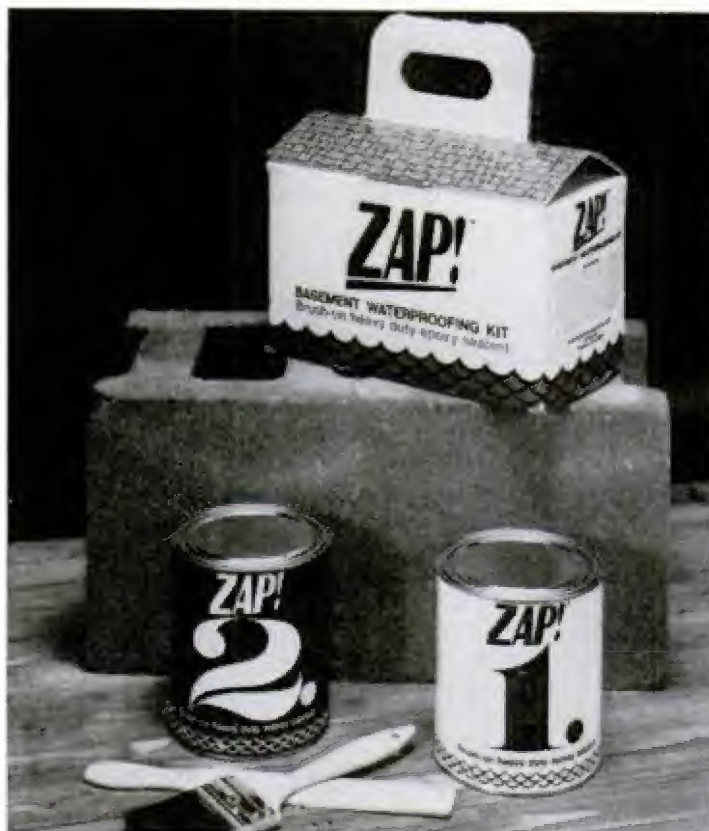
Now you can have year-round Hibachi cookery with a plug-in converter that lets you switch from charcoal to electricity for indoor use. Hooks across any standard 10-in.-sq. hibachi. With converter, hibachi retails for \$12.95; converter alone, \$6.95. Noma-World, 3838 West 51 St., Chicago, Ill.

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Dual-control chainsaw—first of its kind

Heretofore all chainsaws have had just one trigger, but Homelite's new XL-2 (12-incher) has two, a front and rear one. The front trigger is used for close quarters and tricky angles, the rear one for firewood cutting, pruning and felling. Both provide firmer control and greater leverage. \$119.95 at Homelite dealers.



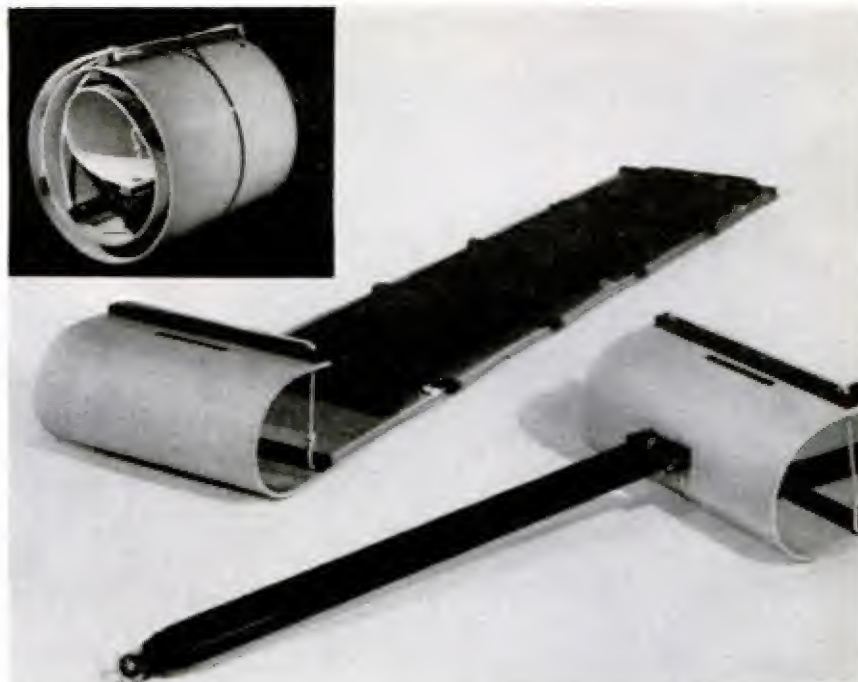
New epoxy sealant ends basement leaks

Zap, a two-part formula used by professional waterproofers, is now packaged for home use. It brushes on, dries quickly, withstands water pressure of two tons per sq. ft. Great for licking leaks in basement walls and swimming pools. Half-gallon kit (\$13.95) covers 100 sq. ft. Construction Chemical Corp., 39 Ross St., Danbury, Conn.

POPULAR MECHANICS

**What will they
think of next—
an 8-ft. toboggan
you can roll up**

Cold, numb fingers tying the old wooden toboggan to the car top are a thing of the past. This one of polyethylene can be rolled up and carted to the hills in a car trunk. Called Sliding Machine, it's made of a very smooth material having a paraffin base that never needs waxing. It's available in 6 and 8-ft. models at \$27.95 and \$31.95 f.o.b. A snowmobile tow bar and 2-in.-thick vinyl pad are optional accessories. Write International Corp., 1442 East Outer Drive, Detroit, Mich. 48234.



**Small speakers get
big sound from
built-in amps, feedback**

These speakers have built-in, 15-watt power amplifiers with direct feedback links that sense speaker motions. When the motions (and, therefore, the output signal) don't match the input signal, the feedback comparator circuit feeds the amplifier a correction signal. According to the manufacturer, this circuit also corrects for the effects of speaker enclosure resonance on frequency response, allowing flat response from an enclosure only $7\frac{1}{2} \times 11\frac{1}{2}$ inches. The speaker/amplifiers, which cost \$160 each, can be used with any preamplifier, tuner or tape deck with a volume control. The preamp shown above them is \$160 separately, \$400 with two speakers. Servo-Sound, Route 222, North Ephrata, Pa. 17522.

FEBRUARY 1973



Old tires never die—they just become grass

Well, they've finally figured out what to do with old auto tires. Goodyear Tire & Rubber Co. of Akron, Ohio, grinds them up into tiny shreds, mixes the particles with a green-colored latex binder and out comes—you guessed it—rubber "grass." A roll of the new artificial turf is shown above being laid down over a playground test area to check its durability under rough use.

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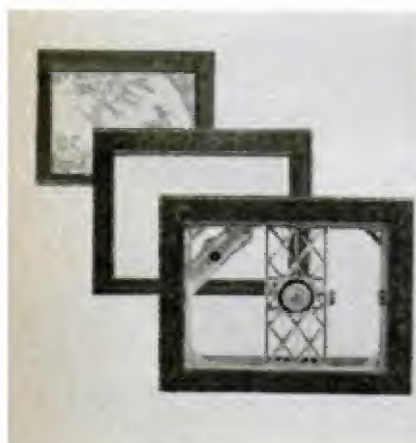


Parking indicator warns cars behind you're about to stop

Many rear-end collisions occur when a car signals to pull over and park. The following car, assuming the driver plans to turn at the next intersection, is caught off guard and is often unable to stop in time. This British Park-O-Matic indicator leaves no doubt about a driver's intentions. Mounted inside the rear window, it has two separately illuminated arrows that read "Park," one pointing left and one right. When a driver wants to park to the right, he simply flips on the right-hand arrow. About \$7. Tragonic Sales, 112 Pkwy., London N.W., 17 A.N.

The blind can hear what they can't see in this audio meter

You don't have to see to "read" this VU meter used in controlling sound levels. Designed primarily to aid blind console operators in recording and broadcasting studios, the special instrument generates an audible tone whenever a monitored signal exceeds the desired volume. The tone varies in frequency according to the amount of signal variation so an operator can easily tell by ear how much the level is off and what adjustment is needed to bring it back to normal. The Audible VU-Meter was developed by Acoustics and Magnetics, a CBS subsidiary.



Wall-hung stereo speakers look like colorful pictures

They look like pictures, but are actually speakers. The slim panels, less than three inches deep, provide both woofer and tweeter and come in eight scenic and abstract patterns. \$138 each. Accessory floor stands also available. Fisher Radio, Long Island City, N.Y.



There's nothing worse than cold pizza

Pizza has to be kept hot from the start, and the Salton Hot-Pizza Keeper keeps every slice hot and flavorful for hours. Its thermostatically controlled tray is perfect for hot hors d'oeuvres too. \$14.95.



Cordless reversible screwdriver

Operating on three flashlight batteries, this powerful no-cord screwdriver will either drive screws or back them out by its two-way switch. Comes with standard and Phillips blades, plus a wood bit. \$10.70 postpaid. Honor House, 35 Wilbur St., Lynbrook, N.Y. 11563.



One-piece abrasive wheel fits any contour

San-Buf is a sanding-buffing wheel that comes with 12 groups of nonreplaceable abrasive-coated fabric strips anchored in a plastic hub. The strips conform to contours as the wheel spins, and when the strips are worn out, hub and all are thrown away. The wheel can be used in a portable drill, drill press, lathe or flexible shaft, and is particularly useful for cleaning corrosion from metal house gutters, car bodies and other nonflat surfaces. Tool comes in three grits—coarse, medium and fine—and is \$2.98. Ali Industries, Inc., 235 Glaser St., Fairborn, Ohio 45324.

FEBRUARY 1973



No, operator, I'm just calling my furnace at home to ask it if it's okay. Doesn't everybody?

With this thermostatic monitor by your phone, you can call home and find out if your heating system is working properly, eliminating the chance of costly damage from freezing, bursting water pipes in case of a furnace breakdown. The device plugs easily in between your phone and wall jack and in no way affects normal phone use. If house heat has fallen below a preset temperature when you call, you hear a warning beep, telling you to hurry home. If all's well, the phone just rings—and you're not even charged for the call. \$59.70 postpaid. Atron Industries, Box 100, Carle Place, N.Y. 11514.



GAF Anscorama 980, \$174.50



GAF 1680
\$99.95



Kodak Carousel 850H, \$204.50



Rollei P37A, \$149.50

Slide projectors get

By BURT MURPHY, /Photos by the author

SLIDE SHOWS are getting more creative nowadays, and the projectors can claim a great deal of the credit. When you don't have to feed slides one by one into a carrier, refocus each slide as the lamp's heat makes it pop, and simultaneously worry about a running commentary, you can concentrate on putting a good show together. But as projectors get smarter, so must you, to make sure you get the one that suits you best. Here's a summary of the more common buypoints, to help you select the right model:

Slide-handling devices for automatic projectors come in three forms: rotary, straight trays and stack loaders.

Rotary trays usually offer the least expensive way to store slide shows—about 3 to 4 cents per slide—but they're also the bulkiest, wasting space in the middle of the circle and at its corners.



PREVIEWER on Honeywell shows you what slide is coming next, and whether it's right-side up or not

POPULAR MECHANICS

Airequipt 670, \$149.50



Honeywell Preview 620, \$144.50

Sawyer's 747AQ
\$177.50Sawyer's Grand Prix 570AF
\$124.95Bell & Howell Slide Cube 977Q
\$119.95

Cavalier 1001, \$74.50

smarter all the time

Straight trays cost more (about 6 to 7½ cents per slide (though Bell & Howell Slide Cubes cost only about 1¼ cents per slide, and La Belle trays hold slides for less than 1½ cents each). But they're a much more compact storage medium (especially Slide Cubes, which hold 640 slides in about the same space as a single round tray). Short trays let you arrange your slide shows more flexibly and gauge their length to your audience's enthusiasm: After you finish a tray, you needn't insert another unless they ask for more.

Stack loaders (about \$6 to \$10) are quick editing devices; you don't have to load slides one by one as you do with trays—just dump in a stack and run them through to cull the bad ones. But you can't run the slides through backwards as you can with most trays.

Knowing which slide-handling options you need will help you pick the right projector. By and large, projectors that

use upright, Ferris-wheel-type rotary trays take straight trays and loaders, too. Projectors with horizontal, merry-go-round trays usually take stack loaders, but no straight trays. And units with upright straight trays, like the Slide Cube and La Belle, take no rotary trays, but their trays can double as stack loaders.

Editing ease is worth looking for, too. Some projectors make it easy to remove and replace slides in mid-show (handy, if a slide is accidentally out of sequence or inverted). Others make it just about impossible. And a few, such as the Honeywell Preview and Bell & Howell Slide Cube projectors, let you see each slide just before showing it, so you can correct errors before the audience sees them.

Autofocus keeps your slides in focus if the projection lamp's heat warps them out of focus, or if you mix different slide mounts that hold the slides in slightly different planes. But it adds about \$30



SLEEK STYLING of Kodak Custom Carousel lets you leave projector out in plain sight without disturbing room decor. Handle (above) folds down when not in use, plastic dust-cover snaps on, and doors cover both lens and remote-cord storage compartment. Power cord wraps around base, leaving only slide tray to be stored. Bell & Howell projectors are also furniture-styled, but are shaped as wood cubes

or \$40 to the cost of your projector, so before you buy, see whether the manual-focus version of the projector you want does make slides pop (some projectors pre-warm each slide before projection to prevent this) and to see how swiftly, silently and accurately the autofocus does its job. (Autofocus systems that grind noisily back and forth for several seconds before settling down are more annoying than the disease they're meant to cure—check this in the store.) A few projectors let you shut off the autofocus system.

Remote control is often a more useful, if more expensive (\$25-\$60), option. Some remotes just advance slides, others let you review previous slides, too, and still others adjust focus, too, walking as close to the screen as the cord permits for maximum focusing accuracy. Almost all remote-control projectors can also be operated by slide-change signals recorded, with your narration, music and sound effects, on tape (see *Liven up your slide shows with sound*, page 126, Nov. '72 PM). Another way to control slide advance is with a timer that triggers a new slide every few seconds. But since different slides normally require different viewing times, it's rarely worth the \$15 or so it usually costs.

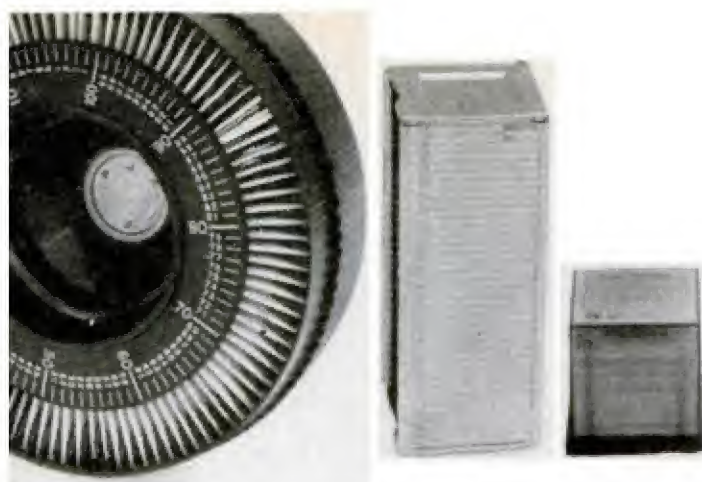
Brightness depends not only on the bulb wattage and the f-stop of the lens (which you can determine from the spec sheets), but also on the design of the optical system (which you cannot so determine). A projector with the usual 500-watt lamp and f/3.5 lens may be as bright as one with a more powerful bulb or faster lens—or may not be as bright as others in its own class. So check before

you buy. Some projectors have lamp dimmer switches, which let you use the lamp at less than its full wattage. This lengthens lamp life, gives warmer colors (which you may or may not want, depending on the subject), and makes overexposed slides look less washed out. Many projectors also let you run the cooling fan awhile after switching the lamp off; cooling the lamp this way before you move the projector lengthens the lamp's life. Another way to lengthen lamp life is to buy a projector with a quartz-halogen (or quartz-iodine) lamp; such bulbs cost twice as much, but have twice the rated life of normal bulbs and don't dim or change color as they age.

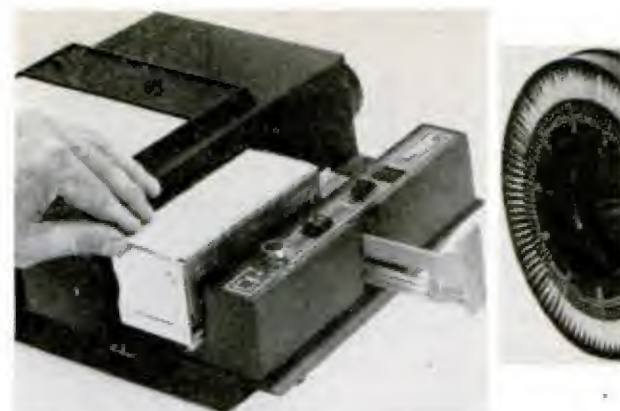
Lenses on most projectors have 4-inch focal lengths, which fill the average 40-inch screen with a 35-mm frame from a distance of about 10 feet. But if you show a lot of 35-mm half-frame slides, or must keep your projector less than 10 feet from the screen, you'll need a short-



TILTING LENS aims Bell & Howell Slide Cube projectors up at screen, takes less effort than tilting entire projector. Note preview window next to lens



IN SAME SPACE as 80 to 140-slide round tray, four 40-slide trays can hold 160 slides; 16 Slide Cubes, 640



AIREQUIPT and other projectors take both round and flat trays, so you can plan your shows more flexibly

er lens; if you show many 126 instant-load slides or 127 Super Slides, or if you'll be projecting across an extra-long room, you'll prefer a longer one. If you intermix several slide sizes, or use your projector in several different-sized rooms, you might want to spend the extra \$30 or so for a zoom lens.

Other convenience features include outlets that turn a lamp off when the projector is on, and *vice versa*, side-to-side leveling adjustments, and slide-storage compartments in the projector case. Some projectors make standard features more convenient, too, as La Belle, with its quick-release projector tilt (and Bell & Howell, with its tilt that elevates the lens instead of the entire machine), or the Anscorama, Cavalier and Honeywell, whose remote controls double as built-in control panels when remote use isn't required.

Some projectors have built-in storage compartments for remote and power

cords (with power-cord retracting reels, on such machines as the GAF Anscorama and Sawyer's Rotomatic 747AQ), which speed up the task of putting the projector away after each show. But wood-grain styling and covers for both lens and changing mechanism on the Kodak Carousel Custom and Bell & Howell Slide-Cube models turn them into handsome boxes that can be left in plain sight—so you don't have to put them away at all. The same might be said of the sleek, modern styling of Rollei's P37 Autofocus, though its design leaves no doubt that it's a slide projector.

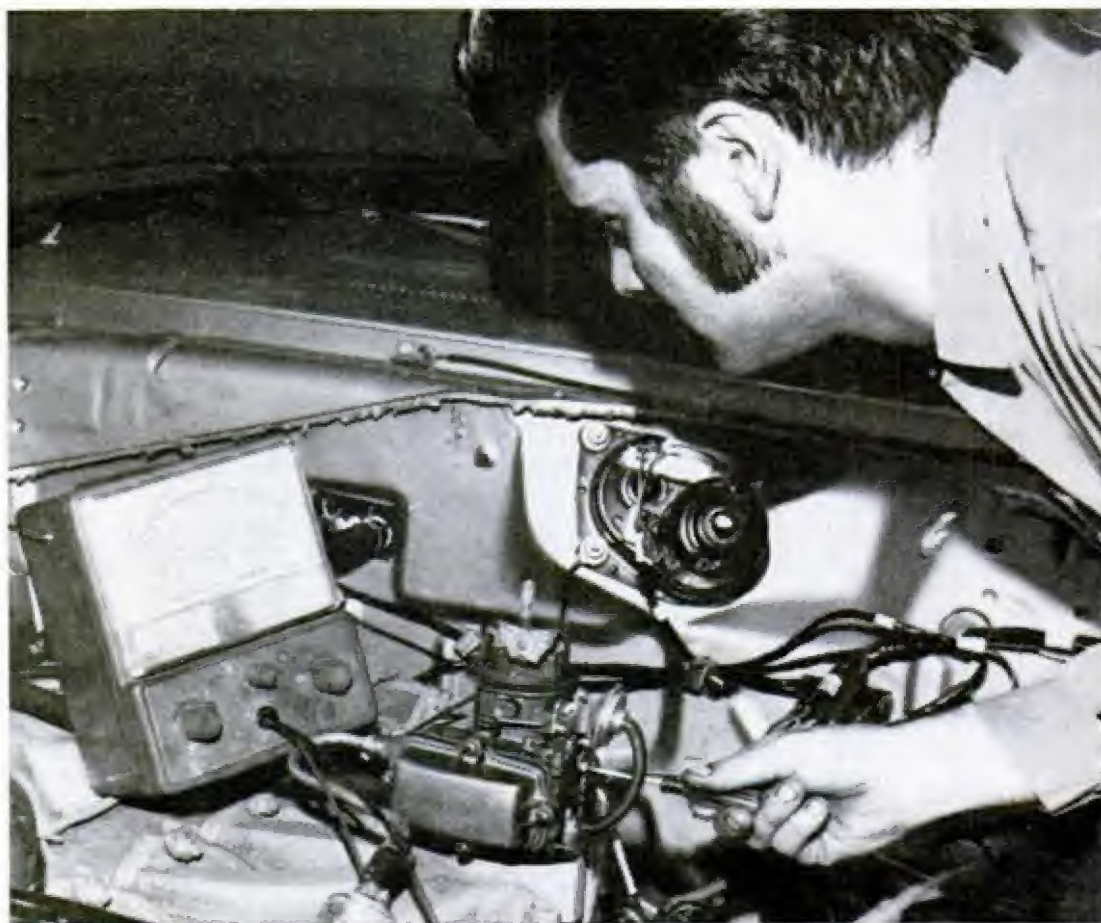
All of the points we've covered so far can be learned from manufacturer's spec sheets. But before you make your final selection, make a few simple checks in person, at the store. Listen to the projectors you're considering, and see if you find their noise annoying. Pick them up by their handles, and check them for weight, balance and handle security (the handle should be part of the projector, not part of its lid); if you have to store your projector on a high shelf, try lifting it above your head, too. See how long it takes to load a box of slides into a tray, and whether the slides will stay securely there, with no danger of spilling. Crumple a cardboard slide, then smooth it out with your hands and run it through the projector, to see how jam-resistant it is: If it does jam, see how easily the jam can be cleared. And compare how two projectors, side by side, project two similar slides—see which is sharper and brighter, how long the focus holds before it drifts, and how long it takes the autofocus (if any) to correct it. ★★★



REMOTE SLIDE ADVANCE and reverse control on this Sawyer doubles as projector's own control panel. Autofocus projectors usually lack remote focus

FEBRUARY 1973

How to stop an engine



FAST IDLE and curb idle speeds should be set at the carburetor using a tachometer (top) to meet manufacturers' specifications exactly. While engine idles, plunger of the idle-stop solenoid (above) is against the throttle lever. When the engine is turned off, plunger should retract. Adjust the hot idle speed by turning plunger (right)



that won't stop

AN ENGINE THAT WON'T START is annoying, but it doesn't scare you. The same can't be said for an engine that won't stop when the ignition key is turned off. It has alarmed many drivers.

The condition is commonly referred to as "dieseling," and is also called "run-on" and "after run." Although frightening, it is not harmful, according to Champion Spark Plug Co. "Engineers are pretty well agreed that the condition, so far as research has been able to determine, does not damage the engine."

Still, it isn't normal for an engine to sputter for several seconds after switch-off, and the vibrations can be fierce.

Dieseling is ignition in the absence of spark. It occurs when fuel in the combustion chambers is ignited by heat.

The problem is particularly common to 1968 and later models that have engine idling speeds set higher than in previous models. Higher engine idling speeds are needed to prevent rough idling that could be caused by the leaner fuel mixtures required to reduce exhaust emissions.

The increase in engine idling speed gives unburned fuel a greater opportunity to enter and remain in the cylinders when the ignition is turned off. The only thing needed to cause dieseling, then, is heat to ignite this unburned fuel.

Present-day ignition timing settings contribute some of the heat. To compensate for the lean fuel mixture, which burns more rapidly than a rich fuel mixture, timing is more retarded than in previous models; that is, it is set to occur later, closer to top dead center (TDC).

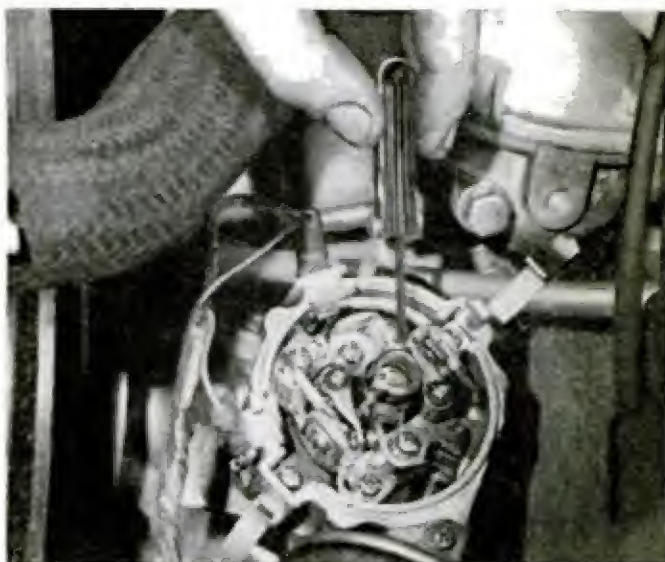
Because spark does occur later in the combustion cycle, the period of time heat has to escape is reduced. Thus, some heat is retained in the cylinders.

Some drivers think that dieseling can be prevented by readjusting the idle mixture (making it richer) and advancing the timing. This should not be done, because it defeats antipollution efforts.

Idle mixture screws of late-model cars have caps over them to prevent anyone from readjusting the mixture to an excessively rich condition. Removing the caps is illegal unless it is done to readjust the mixture in order to

'Round and round she goes,
and where she stops nobody
knows . . .' Don't gamble
that your engine won't shake
right off its mounts: Stop
that dieseling condition now!

By **MORT SCHULTZ**



CHECK FOR DIESELING should include general tune-up procedures like setting distributor-point gap with a feeler gauge. Gap should be set while checking the point dwell angle



bring it into line with emission standards. Once the readjustment is done, the law states that new caps must be placed over the idle mixture screw(s).

Another source of heat that helps to ignite unburned fuel in the combustion chambers comes from the higher temperatures at which modern engines operate for more efficient performance. Most cooling system thermostats are set to open when coolant reaches 195°F.

In addition, more and more engines are running on lower octane fuel. Lower octane fuel burns hotter than higher octane fuel, so this too contributes to the high temperatures present in the combustion chambers.

Cars with automatic transmissions are particularly susceptible to dieseling. Before a driver switches off the ignition, he usually places the transmission selector level in PARK or NEUTRAL. This takes a load off the engine and causes an increase in idle speed, giving unburned fuel a greater chance to enter the combustion chambers.

One method that helps prevent dieseling in cars with automatic transmission is to shut off the ignition with the transmission selector in DRIVE. Be sure the parking brake is set and your foot is solidly placed on the brake pedal.

Some drivers of cars with manual transmissions have found that stalling the engine by engaging the brake and releasing the clutch with the transmission in gear has prevented dieseling. Another operational trick to try is to let the engine idle for several minutes before shutting off the ignition following a long, high-speed trip. These, of course, are temporary measures that can be used until the problem is corrected.

Naturally, not every post-1968 car diesels. However, the problem is widespread enough to cause concern.

The step taken by manufacturers to eliminate dieseling has been the addition of an idle-stop solenoid on some carburetors, especially in those cars with automatic transmissions. The purpose of the solenoid is to let the throttle close when the ignition is shut off, preventing excessive fuel from entering the cylinders.

When the ignition is turned on, a solenoid coil is activated. This drives a plunger against the throttle lever and sets the throttle valve to provide an adequate idling speed. However, when the ignition is turned off, which de-energizes the solenoid, the plunger retracts. This closes the throttle valve.

If your car is dieseling and it has an idle-stop solenoid, the first thing to do is observe the operation of the plunger as the engine is started and turned off. If the plunger doesn't come against the throttle lever with the engine idling and doesn't retract as soon as the ignition is turned off, there is a malfunction or the idle-stop solenoid isn't adjusted properly.

The importance of setting an engine to the idle speed and ignition timing settings recommended by the manufacturer cannot be overemphasized. They must be set perfectly to minimize the chance of dieseling.

Don't confuse engine idle speed, which is also called

curb idle speed or hot idle speed, with the fast idle setting. The fast idle adjustment is made with the engine cold by adjusting the position of the fast idle screw on the fast idle cam. The fast idle speed permits the engine to warm up quickly.

The curb idle speed is set with the engine at normal operating temperature. This means that the engine should be permitted to warm up for about 30 minutes before the adjustment is made.

The curb idle specification for your car, if it is a post-1968 model, is printed on a decal in the engine compartment.

Unlike the old days when every carburetor was set pretty much the same way (an experienced mechanic could do it by ear), you now need the instructions of the manufacturer to set curb idle properly, because adjustment methods differ from one carb to another.

Some models with airconditioning, for example, require that the airconditioner be turned on while the adjustment is being made. Other manufacturers want the airconditioner off. Some manufacturers require that the carburetor air cleaner be in place. Others want it off. Some manufacturers want the transmission in DRIVE, while others want it in NEUTRAL; and some want the headlights on to load the engine with the charging alternator.

The curb idle of cars with idle stop solenoids is usually made by adjusting the plunger of the solenoid. In cars without an idle-stop solenoid, the setting is made by means of a conventional idle speed screw.

Ignition timing should be set with a power timing light after distributor breaker points are adjusted. The relative position of the timing indicator in respect to fixed marks allows you to determine the timing setting. The timing light is connected to the ignition system—normally to No. 1 sparkplug. The other leads are hooked to the battery.

If the indicator is aligned correctly, the timed pulses of the timing light will make the indicator and the timing mark appear stationary. If there is wavering, timing is not set properly and should be readjusted.

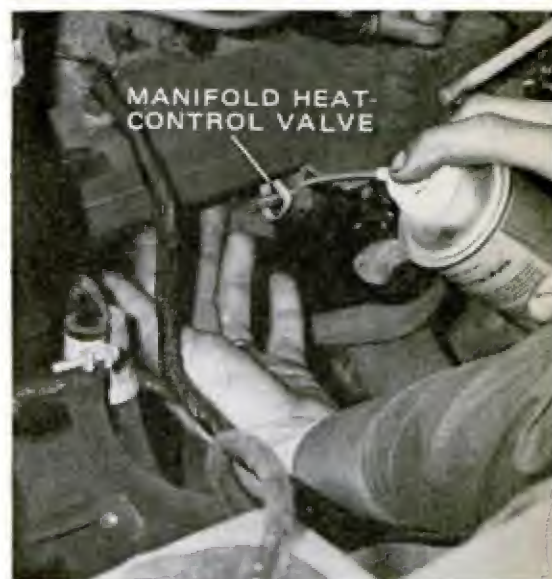
To do this, loosen the distributor housing and turn it. Turning the distributor against the rotor rotation retards timing. After tightening the housing, recheck timing with the timing light.

Any mechanical hangup that allows excessive unburned fuel to enter the cylinders or permits an increase in engine heat could make the difference between having or not having a dieseling condition. One such problem is a carburetor linkage that is dirty and sticking, and is keeping the throttle from closing.

Another contributor to dieseling is a driver who keeps his foot on the accelerator pedal as he turns off the ignition key. This, of course, keeps the throttle open wider than necessary.

A manifold heat control valve stuck in closed position will trap hot exhaust gases in the engine. Be sure the

(Please turn to page 198)



MANIFOLD HEAT CONTROL valve can be checked for proper operation by turning counterweight by hand with engine cold (top). It should operate freely with no binding. Manifold heat control valve lubricant will help free stuck valve

HINTS FROM READERS

Scraper from plane iron

You get double duty from a hand-plane blade when you fit it with a bolt handle. Attach the bolt ($\frac{5}{8}$ x 7 in.) at the bottom of the slot with two nuts and washers. The blade does its cutting when pulled with the bevel side of the edge trailing. A piece of slotted broomstick provides an optional grip.—*Hedy Irwin, Boston*



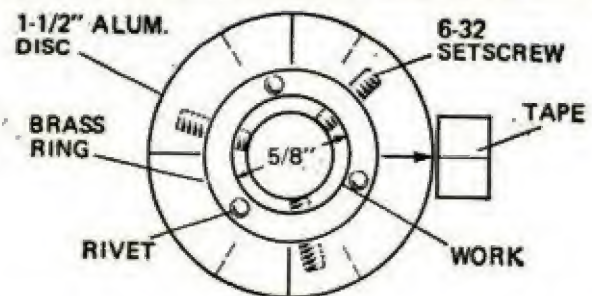
Indexer for milling flats on rods

When machining square or hexagon ends on rods in a milling machine, I use this simple indexing setup consisting of a calibrated disc and a witness mark.

Here's how it works: The disc is first slipped over the rod and its setscrews tightened. Then the rod is positioned and clamped in the V-jaws of the vise with the disc against them, and a piece of tape with a line drawn on it is stuck to the vise where it will align with the disc calibrations.

In use, one flat is milled, the vise loosened, rod and disc turned to the next index mark and the second flat milled. If you are milling four flats (square) follow the solid lines on the disc; if five flats (hexagon), follow the dotted lines in conjunction with two solid lines. The disc bearing against the vise serves as a stop for the rod.

The 1½-in. aluminum disc with the center cut out is riveted to a brass ring which in turn is fitted with three 6-32



setscrews 120° apart. The indexer will handle rods up to $\frac{5}{8}$ in. in diameter.—*Walter E. Burton, Akron, Ohio.*

NEXT MONTH IN SHOP AND CRAFTS

THE PLEASURE OF CLEAN AIR. Your home will be a cleaner and more healthful place to live when your furnace is equipped with an electronic air cleaner. It traps the microscopic particles of dirt, dust and smoke the usual fiberglass filter can't, cuts decorating needs and drapery cleaning, and costs less to operate than a 40-w. light bulb. You can add one to almost any forced-air furnace.

CHOICE OF FOUR SEWING CENTERS. Like any work center, the more organized it is the more convenient a place it is to work. This is certainly so in the case of a sewing center when everything is in one handy place. Designs range from a simple fold-down wall affair to a 6-ft., freestanding cabinet with compartments galore for storing the machine, cutting board, dress form, iron and pressing board, material, patterns—the works. Have your wife take her pick—and build it for her.

HOW TO make a high-low drill-press fence, cut and splice wires, frame a new basement partition, hang drapery hardware, fix a bad spot in a linoleum or vinyl floor.

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How to replace a broken window pane

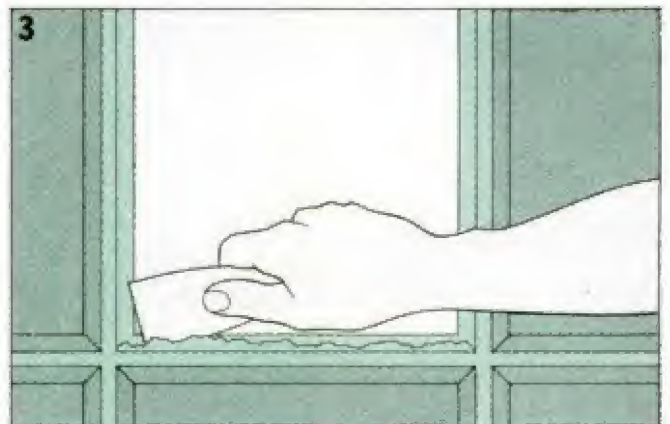


1 Heating old putty with flame of torch softens it, makes it easier to remove. Avoid scorching wood by using shield of scrap tin and move it as you go.

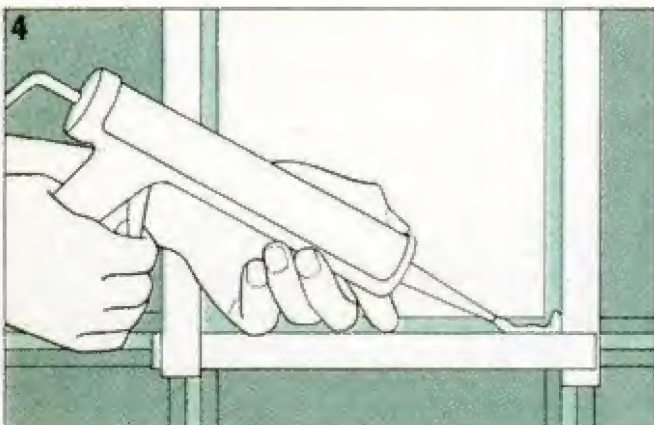
BASEBALLS and other flying objects have a way of breaking windows, and sooner or later most homeowners can count on having to replace a shattered pane. Knowing how to loosen the old putty, bed the new glass, hold it with glazier's points and strike a neat bevel when applying the putty seal will save you the frustrating job of trying to get someone to come and fix it—and let you pocket the savings. A propane torch and caulking gun make the job go faster, but they are not essential. If you work carefully, you can remove the old putty with a sharp chisel, and you can apply the putty by hand without a gun. A hammer and a putty knife are the only other tools you'll need.



2 Safe way to remove a cracked pane is to cover it with strips of masking tape and crack further with hammer. Wear glove when pulling out broken pieces.



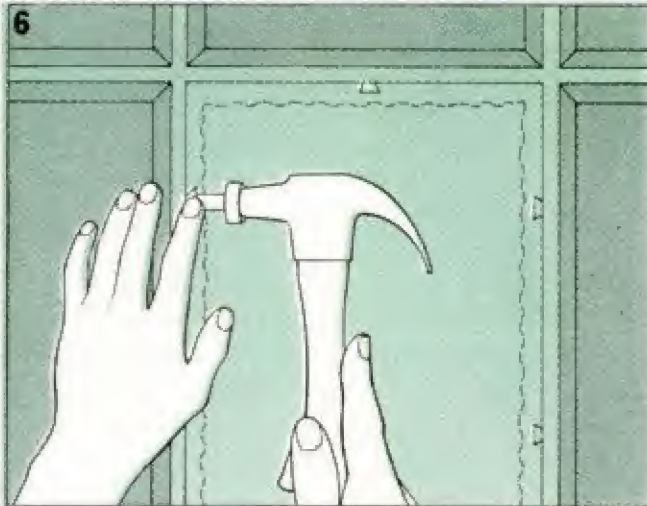
3 Scrape putty clean from rabbet with knife or chisel, pry out old glazier's points and brush rabbet clean. Seal bare wood with thinned oil-base paint.



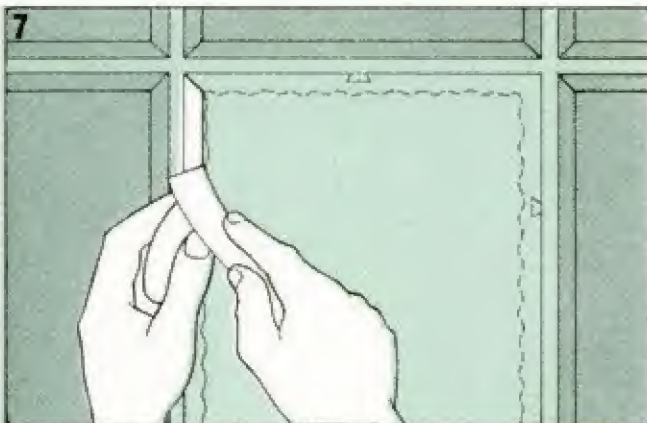
4 Silicone rubber sealant or regular putty can be used to bed the glass. If silicone is used, outline opening with tape to keep off adjacent panes.



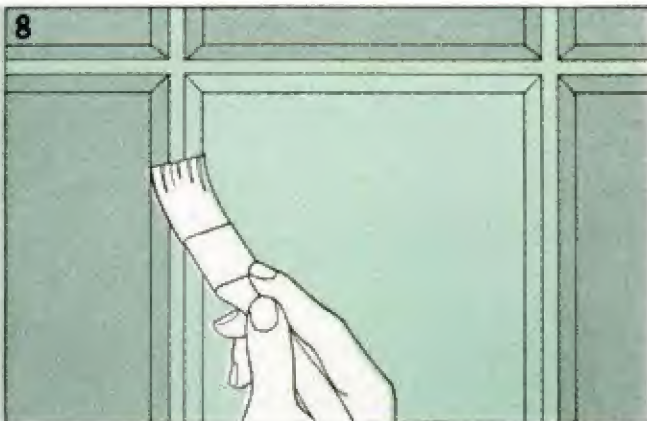
5 Press new pane (with 1/16 in. allowance all sides) in place until sealant oozes around edges for tight seal. Excess on inside is removed with putty knife.



Drive glazier's points, size 1 or 2, using driving tool packaged with points. On small pane use one point along short sides of glass, two on long.



For final bevel, silicone or putty is smoothed with putty knife dipped in solvent or turpentine to keep material from sticking to the knife blade.



If putty is used, it should be painted several days later when it's dry. Painting the new putty improves appearance and keeps it from shrinking.

Facts about window glass

THE GRADE OF GLASS that's used in a particular window has a lot to do with the location of the window. A living-room window, for example, calls for better glass than a basement window. Optical ripples in the glass of a basement window would be unimportant, but you wouldn't want such imperfections in a living-room window.

Polished plate is generally used in windows you look through, whereas *common*, or *grade B sheet*, is for basement and attic windows, which are primarily for light. Knowing a few simple facts about the different types and grades of glass will help when a window has to be replaced.

Window glass is drawn while molten in sheets through an annealing oven. In the process, it's almost impossible to avoid slight variations in thickness that cause optical ripples. *Grade AA* has the fewest, *grade A* has more and *grade B*, known as *common*, even more.

Plate glass is annealed like regular window glass, but afterward it's ground and polished.

Recommended weight (or thickness) will depend on the size of the pane. Sheet window glass is single-weight ($3/32$ in. thick) and is safe normally in sizes up to 2x2 ft.; double-weight ($1/8$ in.) will go to 3x5 ft.; heavy-weight ($7/32$ in.) is recommended where there are high winds or other dangers of breaking.

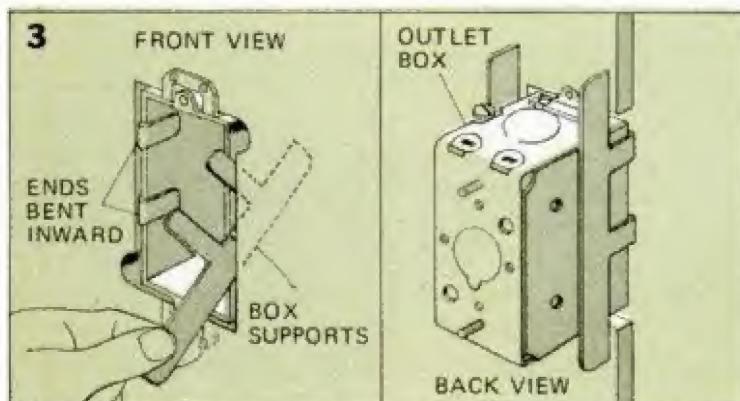
Plate glass ranges through weights of $3/16$ in., $7/32$ in. and $1/4$ in. on up to commercial weights. The $1/4$ -in. weight is for large window walls and sliding glass doors. Heavy sheet glass is a useful grade for special applications where slight distortions won't be noticeable, such as table tops and shelves. Its fired surface is less likely to scratch than that of polished plate. It's available in $3/16$ and $7/32$ -in. thicknesses and it comes in grades AA and B. ★★★

How to add a new convenience outlet

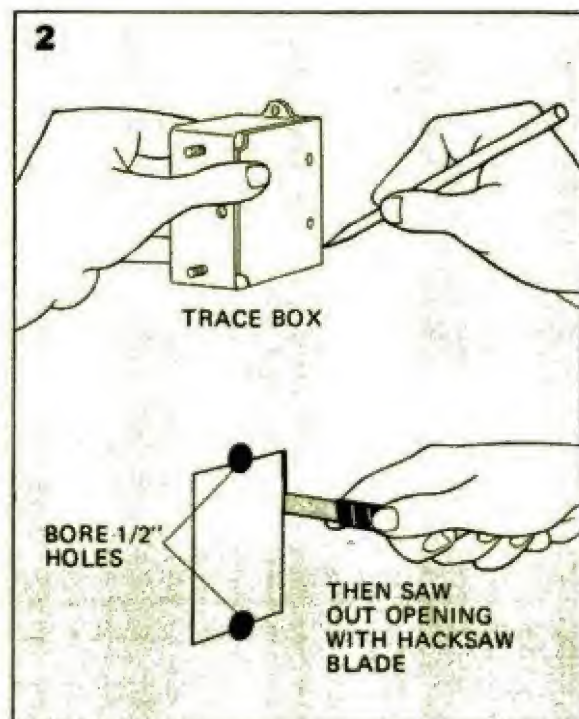


Anchoring outlet box in a wall

If the wall is lath and plaster, you simply attach the outlet box to the wood lath with small screws. If the wall is plasterboard, the box is anchored in the hole with special metal supports, as shown below. To install the metal supports, you work one along each side of the box and move it up and down until it is against the inside surface of the wall. Then bend the projecting ears inside the box, as shown in the lower left-hand drawing. All hardware is available at electrical supply stores.



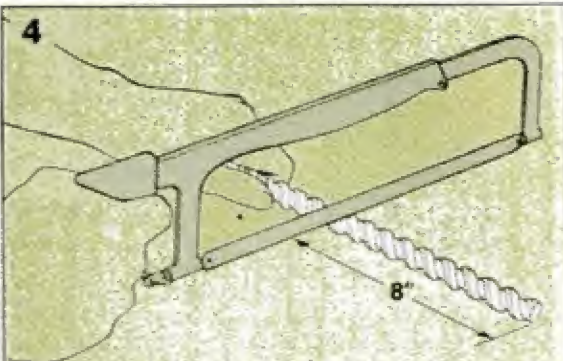
ROOMS in older homes never seem to have enough electrical outlets, and many times you end up using a long extension cord to plug in a lamp across the room. Adding another outlet and tying it to an existing one is a job you may not really hate to do but one you may not know how to do. The steps illustrated and described here show how simple it is to cut the hole, install the box, prepare the wire and make the actual connection. And you can say good-bye to hazardous extension cords.



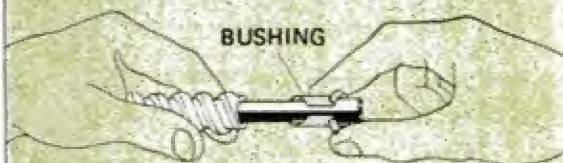
Cutting hole for box

If wall is plasterboard, it's not necessary to chip hole to locate and center the box over a full lath. Simply trace around the box and drill two ½-in. holes through the wall at the top and bottom half-round notches. Similar holes are made in a lath-and-plaster wall. The box opening is cut out with a hand-held hacksaw blade. If sawing lath, draw the saw teeth toward you. Wrap the saw blade with several turns of tape for a more comfortable grip, or wear a glove. The drilled holes provide clearance for the projecting tabs at the top and bottom of all outlet boxes. They also make it easy to insert a hacksaw blade or keyhole saw.

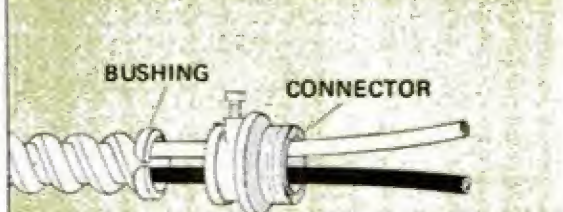
How to install armored cable



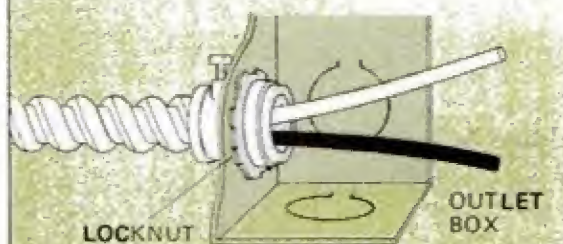
To cut armored (BX) cable, hold your hacksaw at approximately a 45° angle, cut through one section of the armor, then twist to break the armor. Do not cut into the wires.



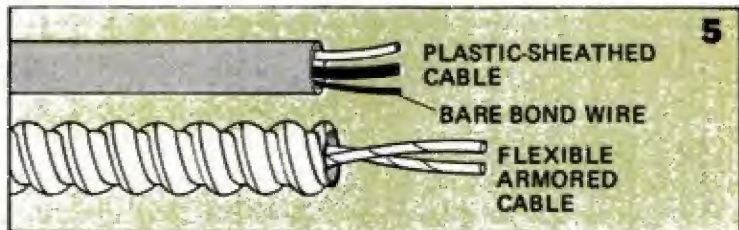
Pulling off an 8-in. section exposes the paper-wrapped wires. Insert an antishort bushing between the paper and cable to protect the wires from the barb end of the metal cable.



Remove paper from wire, slip a connector with locknut remover over end of cable and tighten screw. Be sure bushing is against connector.

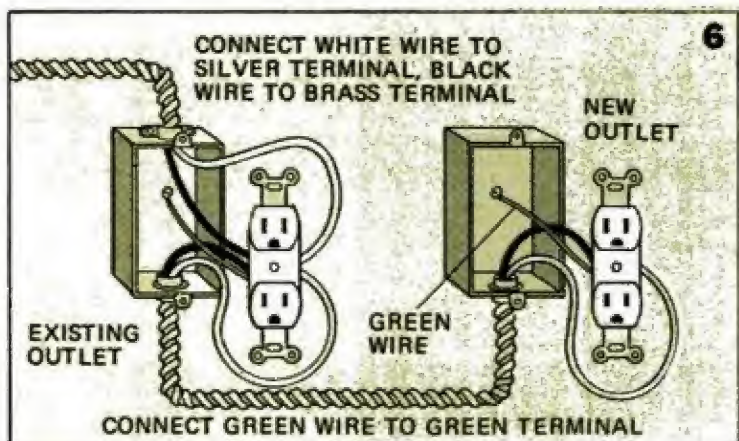


Connector is inserted through knockout hole in outlet box. Locknut is slipped over connector and drawn up tight with hammer and screwdriver.



Two kinds of cable you can use

You have a choice of using armored cable or plastic cable to wire your new outlet. Armored (also called BX) has a flexible-steel covering that requires a hacksaw to cut. The covering on plastic cable can be cut with a knife and it's easy to pull and strip. The national code requires a cable having a bond wire, as shown above. In the case of armored cable, the cable armor itself serves as the bond. In the case of plastic-sheathed cable, a separate bonding wire is attached to the outlet box with a screw or special clip, or the cable is connected to a box that's equipped with a bonding jumper. Thus your new outlet will have continuous bond, provided the rest of the system was originally bonded. Be sure that when you connect the cable to the terminals on the old outlet that you connect black wire to black wire and white wire to white wire.

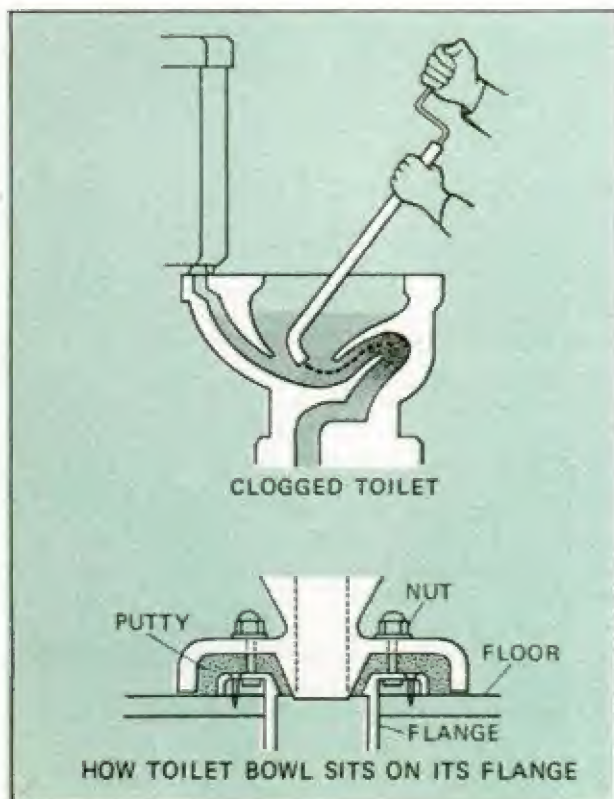


Routing the cable from box to box

How you run the cable from existing box to new one depends on where the boxes are located. If they're on the same wall, you can remove the baseboard, notch each stud to accept the cable and cover with metal kick plates for protection. If boxes are on different walls and there's a basement below, it's easier to bore up into the walls from underneath and run the cable across under the joists. If the new outlet is on the other side of a doorway, the cable can be concealed behind the trim, usually by chipping out the plaster or wallboard, and run up and over the door. Be careful, though, in reattaching the trim not to nail into the cable. To connect the cable to the old box, pry open a knockout and fish a thin wire through the hole to pull the cable into the box. *Remember to turn off the electricity* before you make the final connections.

OPENING DRAIN WITH FORCE CUP

When a sink or lavatory won't drain, there may be a stoppage in the trap (that U-shape fitting right below the bowl). Often a force cup will dislodge it without your having to touch the trap. Fill bowl up to 8 in. or so with hot water and temporarily plug the overflow hole (if there is one) with an old towel. Then pump forcibly up and down until the water flows normally. If pumping fails, you'll have to syphon water from the bowl and take off the trap.

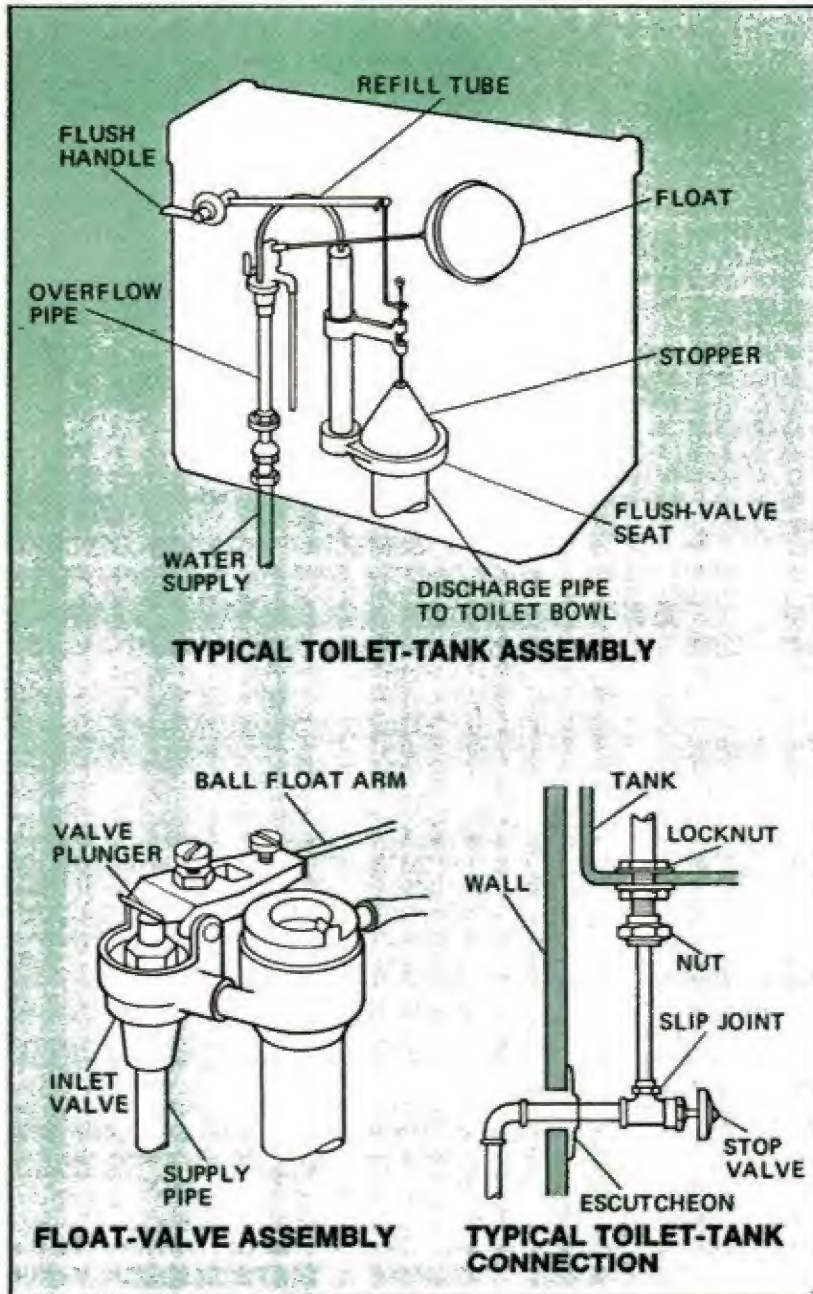


HOW TO REMOVE A LAVATORY TRAP

The diagram illustrates the process of removing a lavatory trap. The top section shows a hand using a **DRAIN AUGER** to clear a clog in the **TAILPIECE** of a **LAVATORY**. The bottom section shows the disassembled components: a **SLIP NUT**, a **RUBBER WASHER**, and the **TRAP** itself.

Some sink and lavatory traps have a cleanout plug on the bottom that lets you clean them out without removing them; others don't. If you have to remove the trap itself, unscrew the two large slip nuts at the top with your large-jaw wrench. If you find the stoppage is beyond the trap, you'll have to use your drain auger and go into the waste pipe that enters the wall.

Youngsters can play havoc with a toilet by dropping something in it and clogging the trap. Too much paper will clog a toilet, too. The first thing to try is the force cup. If the obstruction is just paper, pumping the cup forcefully will generally dislodge it. If the stoppage appears to be more than paper, see if your toilet auger will reach the item so it can be pulled back out. If these methods are not successful, then you'll have to lift the toilet from its flange and remove the obstruction from the underside.



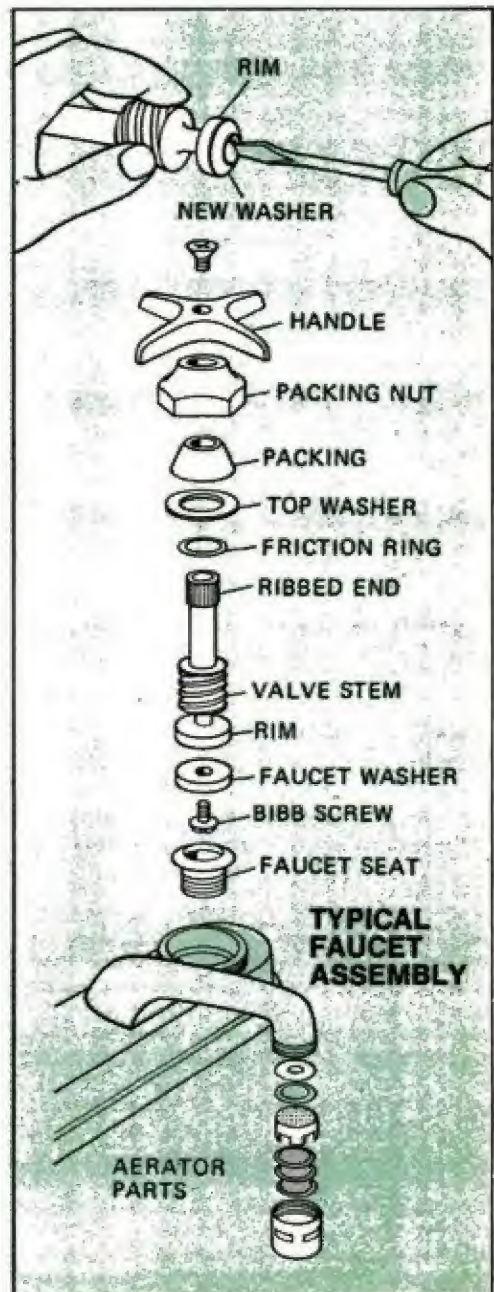
When a toilet continues to trickle

When water trickles into the toilet bowl after flushing, it may indicate that the rubber stopper valve (see drawing) has become "water-logged" (mushy) and needs replacing. If the trickle persists, examine the stopper seat; it may be corroded and gritty around the edge, letting water escape. If so, clean it with emery cloth. If it's not the stopper or seat, then it could be a worn washer in the valve assembly. To replace it, you will have to shut off the water. Most toilets have their own shut-off valve right below the tank. Older ones don't, in which case you'll have to shut off the water at the meter. If the toilet is old, it may be best to replace the entire float-valve assembly. Removal of the nut and washer from the end of the assembly will make it easy for you to lift out the entire unit. Use the nuts and washers that come with the new assembly to install it.

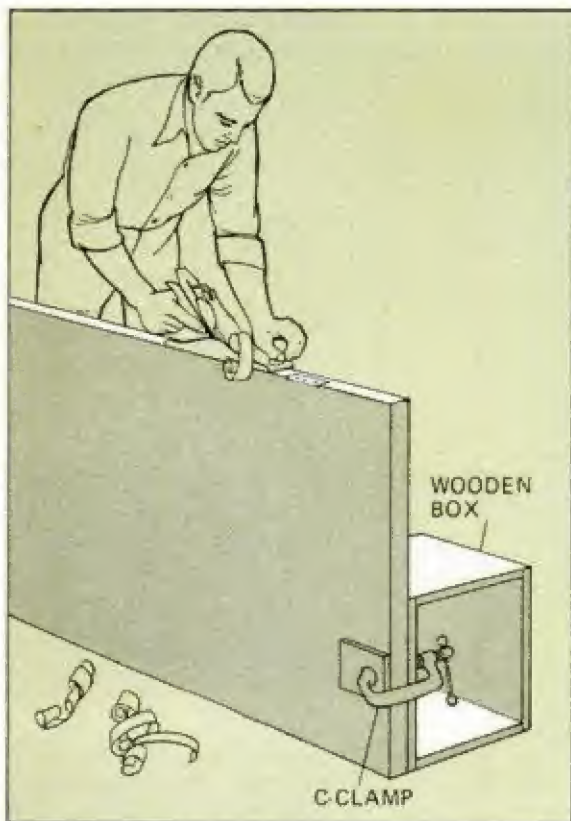
FEBRUARY 1973

When a faucet starts to drip

To reach a worn faucet washer at the end of the stem of a compression-type valve, you first remove the screw on the top of the handle. Next you pry the handle off the ribbed end of the stem and lift off the packing nut. Some packing nuts screw on, in which case you protect the chrome finish from wrench marks by first wrapping it with adhesive tape. Now you simply back out the stem with the fingers, turning it *counterclockwise*. To replace the washer, you back out the r.h. bibb screw that holds it.



How to trim and plane sticking doors

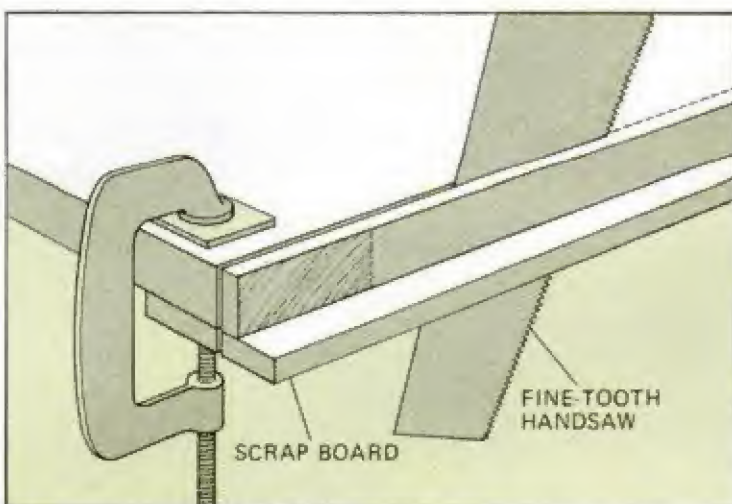


When a door must be planed

When a door continues to stick even during dry weather and is hard to open, the only way to fix it is to plane it. Planing is done along the hinge edge of the door since you can't disturb the lock. Take down the door, remove its hinges and support it on edge. A wooden box is a good thing to clamp it to. If you must plane top and bottom, work from edge to center so you won't chip the corners.



EVER HAD a door bind so it wouldn't close, or it wouldn't swing over a thick, new carpet? Few homeowners haven't had these problems with doors—particularly binding, for most wood doors swell periodically. Sometimes they expand so much they never shrink back to their former size. When that happens, you have no recourse but to remove the door and plane it. Or you must trim it with a saw if it's binding on a carpet. Not all doors bind because of moisture. Sometimes one won't operate properly because the screws have worked loose in a hinge, allowing the door to droop enough so that it won't open and close the way it should.

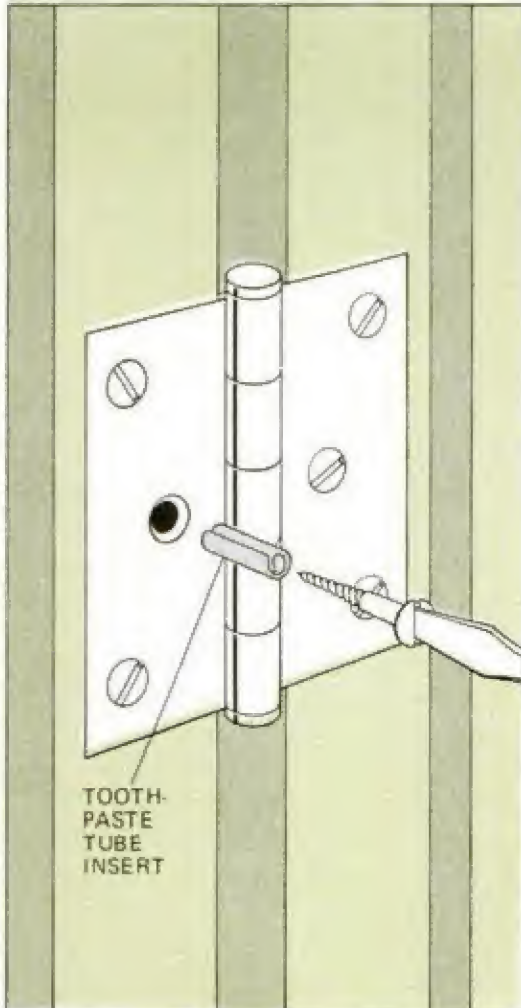


When you have to shorten a door

When a new carpet is thicker than the old and a door drags on it, watch that you don't chip one side when you cut the door. Determine the amount you must take off, and draw a line across the door. Take the door down by knocking out the hinge pins, support it on a couple of padded sawhorses or boxes and clamp a scrap board to the underside of the door. The board not only prevents chipping the thin plywood facing on interior doors but helps keep the saw from running off the line when sawing as little as $\frac{1}{4}$ in. Use a fine-tooth saw.

When a door needs sealing

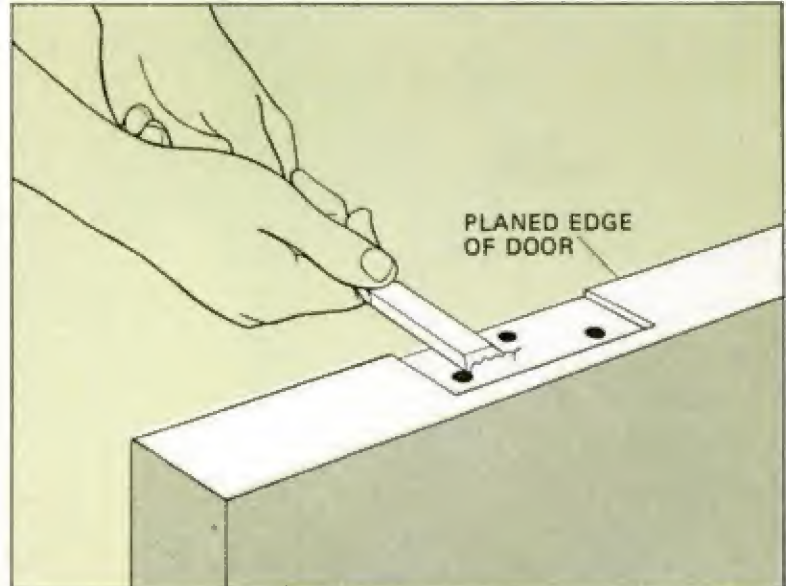
Doors usually swell during prolonged periods of rain, ice and snow. When the top and bottom edges of a door are not sealed, excessive moisture can enter the open end grain and cause the wood to expand and the door to widen. Common shellac is good for sealing the wood against moisture and it dries quickly, but you should wait for a dry spell; you don't want to seal the edges and trap any moisture that may be in the door at the time. Of course, to coat the bottom edge you must take the door down.



When hinges work loose

Like anything that is used a great deal, a door that is opened and closed frequently puts a strain on the hinges that can eventually cause the door to bind. Usually you will find that a screw or two has worked loose, even to the point where it will no longer hold. When the trouble is found to be an enlarged hole, this hole must be shimmed. Sometimes a wooden matchstick and a little glue will do the trick, but an even better shim is one that's rolled from the soft metal of a toothpaste tube. Like a lead anchor, it will let the screw threads cut into the shim and spread it to fill the hole. Regular plastic screw plugs also can be used to shim an enlarged hole. In this case, the screw makes the plug expand and anchor itself tightly in the hole.

Illustrations by Adolph Brotman

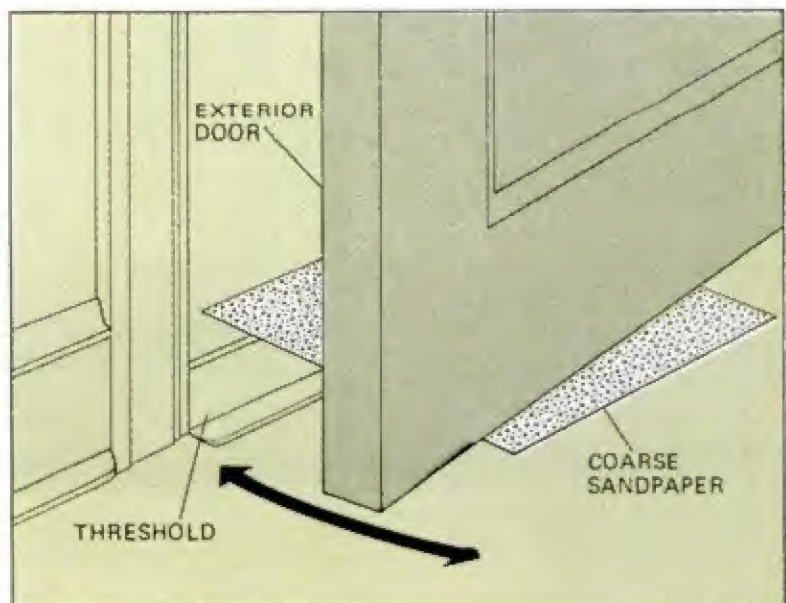


When you have to plane off a lot

When you have to plane off more than a little to relieve a binding door, you have to chisel the hinge pockets deeper to compensate for the amount you take off. Try to pare them an even amount. A properly set hinge leaf should be slightly deeper than flush. When the door has been planed enough to close properly, repaint the planed edge.

When a door drags on its threshold

If you can sand the bottom of a heavy exterior door that rubs on the threshold without removing it from its hinges, it's worth a try. A stunt that often does the trick is to work a sheet of coarse garnet paper under the door as shown below and then move the door back and forth. Little by little it will sand enough off to relieve the rubbing. When the dragging is beyond the sandpaper trick, you'll have to plane it.



Now: A plastic injector



STRIPS OF TAPE on drill-press base provide quick way of positioning mold each time when making production run. Drill press must be sturdy to exert needed pressure



SAMPLING OF MOLDS AVAILABLE show few of many plastic items you can mold and sell: star tree ornaments, sign and nameplate letters and novel hosiery hangers

YOUR WORKSHOP DRILL PRESS becomes even more versatile with a unique new accessory, called Quick Shooter, which converts any suitable drill press into an efficient injection molding machine.

You just tighten its plunger rod in the drill-press chuck, plug the unit into a 115-v. outlet, wait until it's hot enough and you're ready to mold by pressure countless items in thermo-plastic materials in ready-made take-apart molds. The drill-press table supports the mold which is held in a regular drill-press vise (or C-clamp) and the drill-press handle works the injector plunger.

To ready the injector, it must be "pre-packed" to assure ample molten plastic down and around the torpedo spreader at the bottom of the heating chamber.

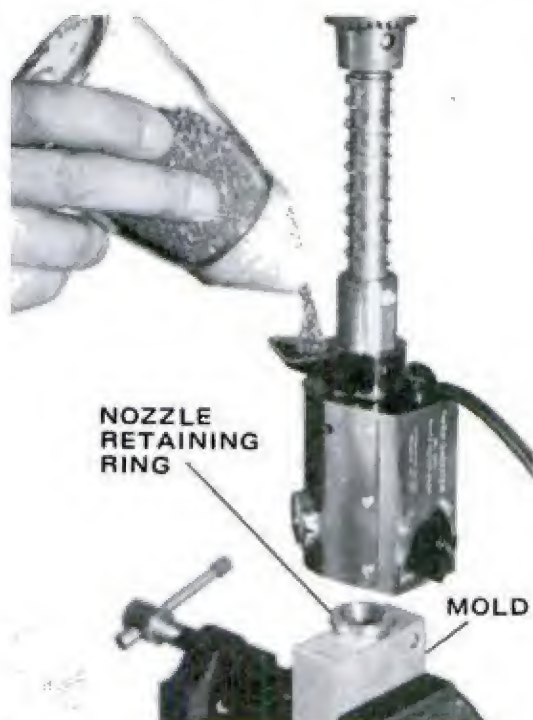
To do this, first unplug the drill press for safety reasons and set the thermostat on the heating chamber a little past medium. Then position the mold so it blocks the hole in the nozzle when the injector is lowered.

When the temperature dial reads 350° F., the proper melting temperature, pour enough plastic pellets in the fill spout and pull down on the drill-press handle. Raise the handle, add a few more pellets and pull it down again. The injector is now ready for use.

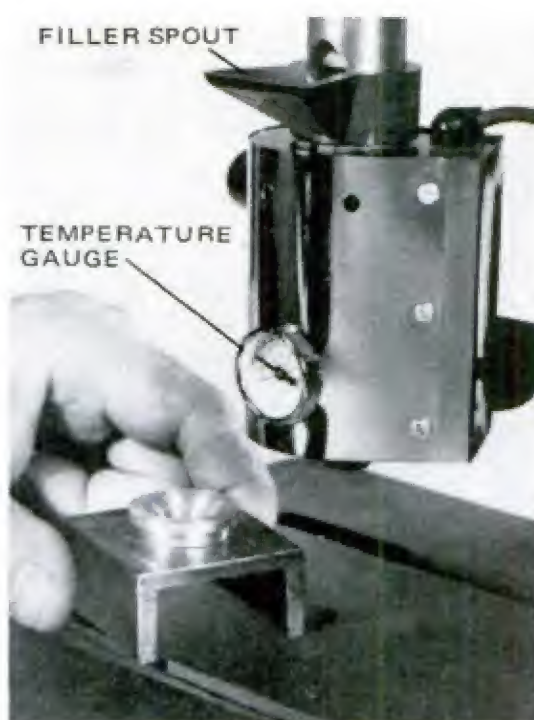
To mold a part, line up the fill hole in the mold with the nozzle and pull down on drill-press handle until nozzle seats in the retaining ring on top of the mold. Now with a continued steady pull force the hot molten plastic into the cavity in the mold. When it's full, hold the pressure two or three seconds, then raise the handle. The hot plastic cools and hardens quickly and you can open the mold and remove the part immediately. When you want to switch color or type of plastics, the injector is emptied by purging with the block provided.

The kit includes the injector, sample star mold, purging block, nozzle retaining ring, plastic pellets and instruction booklet. For information on additional molds and price of the kit write Haygean Machine Corp., 2175 South 170th St., New Berlin, Wis. 53151. ★★

for your drill press



INJECTOR IS FILLED with plastic pellets through top filler spout, holds $\frac{1}{2}$ ounce



INJECTOR IS CLEANED of leftovers by placing purging block and ring under the nozzle

PHOTOS BY ROBERT D. HORST



PARTS OF BASIC KIT

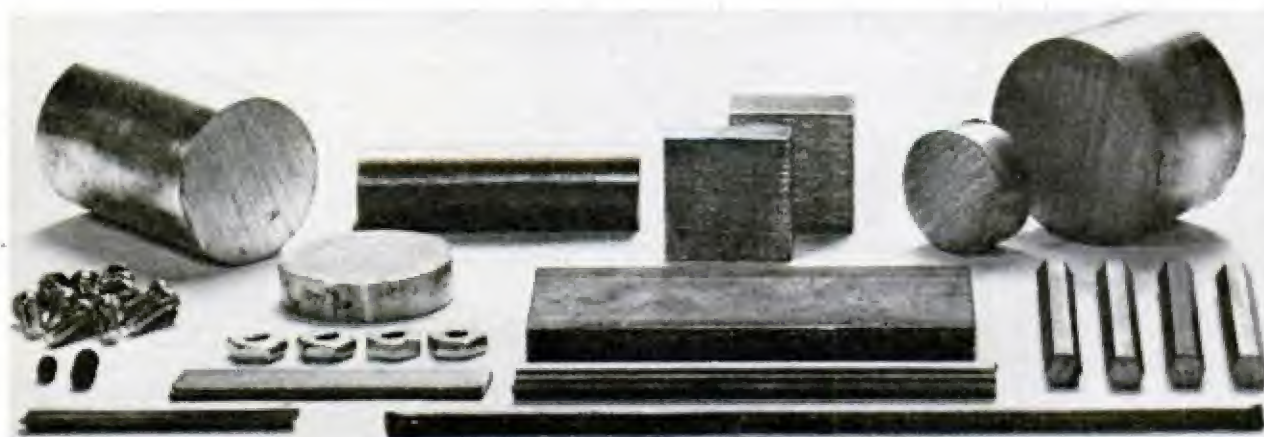
EVERYTHING YOU NEED is provided in this kit, including a sample mold. Additional molds are available
FEBRUARY 1973

Tiny steam engine

By JOHN BURROUGHS

THIS LITTLE STEAM ENGINE (a mere 3 in. long) is a simplified version of a vertical open-column marine engine that was used in the 1800s to power chugging steam launches such as the *African Queen*. It makes a good starting project for the new owner of a modelmaker's lathe. The step-by-step photos show how simple it is to machine. It has a single-acting $\frac{1}{2}$ -in. bore and an easy-to-fit rotary valve. The completed engine will run either with steam from a small boiler or with air from a paint-spray compressor.

A kit packaged by Caldwell Industries includes everything you need—cut chunks of metal, screws, nuts, drawings and instructions. It's available at Unimat dealers or from American-Edelstaal, Inc., 1 Atwood Ave., Tenafly, N.J. 07670 for \$4.95 post-paid. Plans and instructions alone, \$1. ★★



- 1** **PACKAGED FOR YOUR CONVENIENCE** (if you can't find the materials locally) is a kit that includes rough-cut metal plus fastenings. It is available at Unimat dealers. Look in local directory for address



- 2** **BORE FLYWHEEL** for a $\frac{3}{16}$ -in. shaft hole and finish-turn it on shaft to make it run true



- 3** **TURNING SHORT TENON** on the cylinder will simplify chucking for turning and boring



- 4** **FINISH-BORE CYLINDER** to accept piston. If you lack a boring tool, grind an old file
- POPULAR MECHANICS**

for the beginning 'machinist'



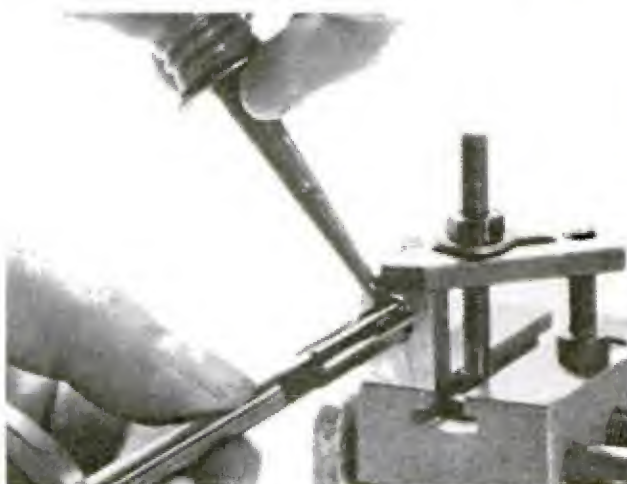
5 DRILL BASE PLATE, use it as a template to locate holes for the cylinder, block, bearing



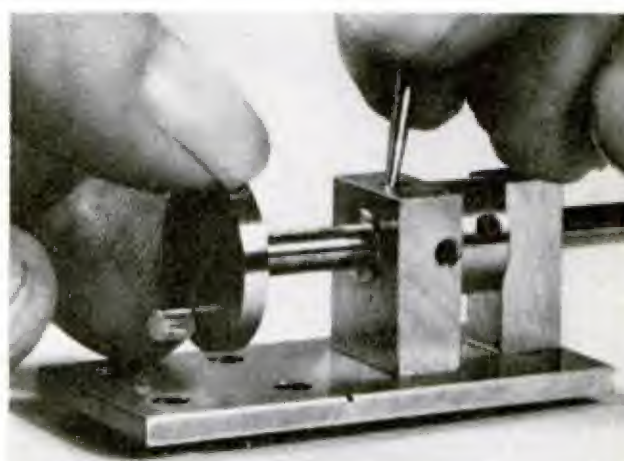
6 TO TAP HOLES, chuck, tap, turn chuck by hand, remove work, finish tapping hole by hand



7 SCREW CRANK-DISC on the shaft, chuck it in the lathe and then turn disc to run true



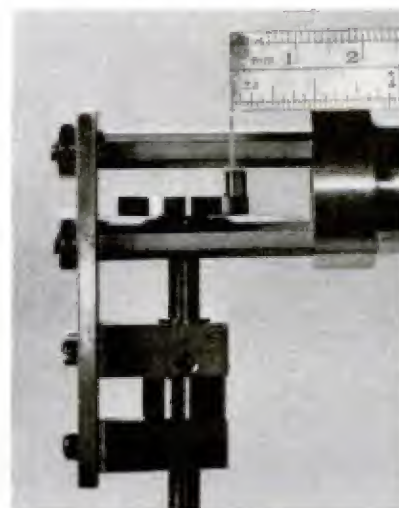
8 VALVE-BLOCK HOLE must be smooth. Drill it undersize, then follow with a $\frac{5}{16}$ -in. reamer



9 TO SLOT PISTON for a connecting rod, use a slotting saw or cut $\frac{1}{8}$ -in. slot with hacksaw



10 CUT CONNECTING ROD so it just clears cylinder head with crank pin (top center)
FEBRUARY 1973



11 CONNECTING - ROD length is taken from model. Piston should just clear the head



12 BEND CONNECTING ROD to a slight offset that will allow it to clear the crank disc



A real drum table

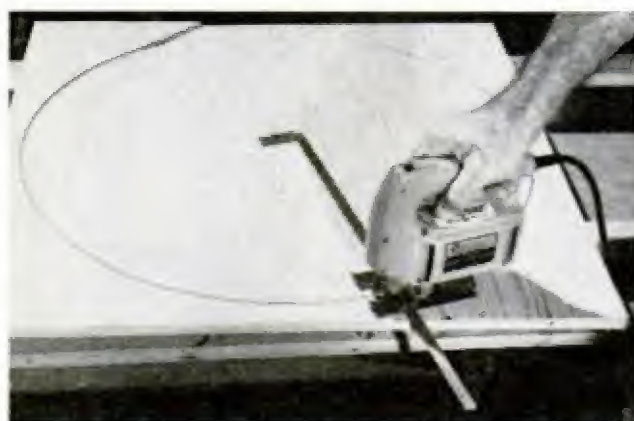
By ROSARIO CAPOTOSTO

HERE'S THE REAL McCoy in a drum table. Not only is it made from a bass drum, but it looks like a drum. For this reason it makes a most appropriate coffee table for a game or recreation room. It has a spillproof, laminate top and three novel drumstick legs.

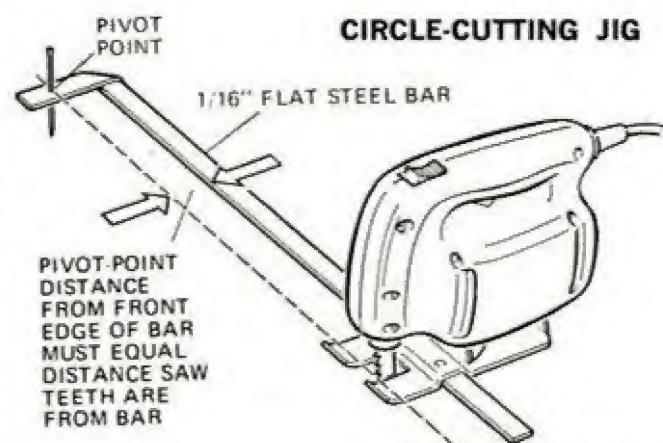
While you may not "just happen" to have an old, spare drum lying around,

old drums are available. Musical-instrument repair shops, pawn and thrift shops and especially the classified ads in your local buy and sell publications are good sources. You need only the shell; the skin, therefore, can be in any state of wear and tear so you should be able to pick up one quite reasonably.

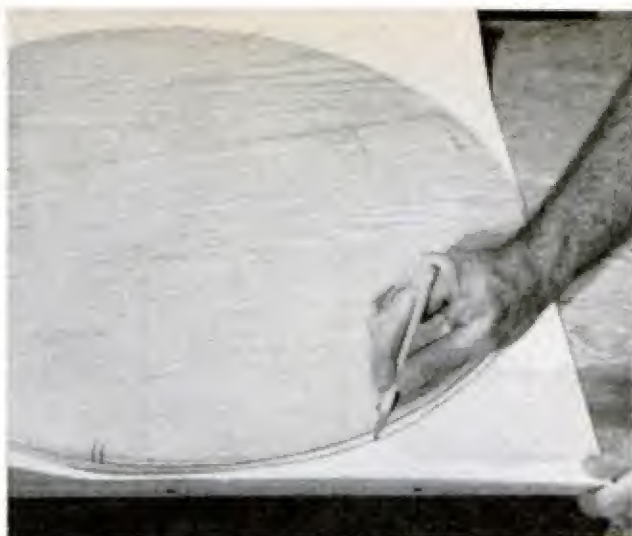
If the drum is in need of refinishing,



1 PIVOT JIG used with sabre saw makes an easy job of cutting plywood tabletop perfectly round



POPULAR MECHANICS



2 TOP OUTLINE is traced a bit oversize on laminate to allow for an error in placement on work



3 THIN CONOLITE LAMINATE is easily cut with common tin shears. Sharp knife can also be used



4 "L-SHAPE" NAILS are used to hold edge of the curled laminate flat when applying cement



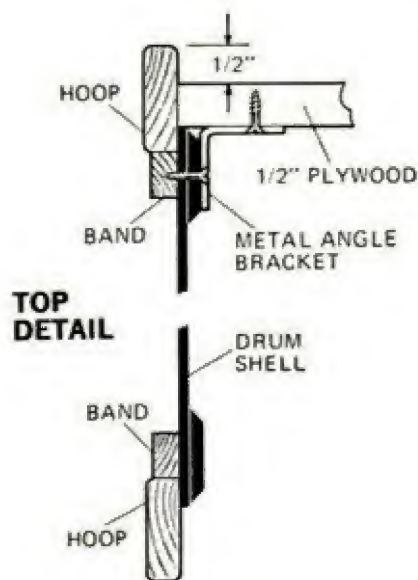
5 AFTER LAMINATE IS BONDED to plywood, use bevel cutter in router to trim the laminate flush



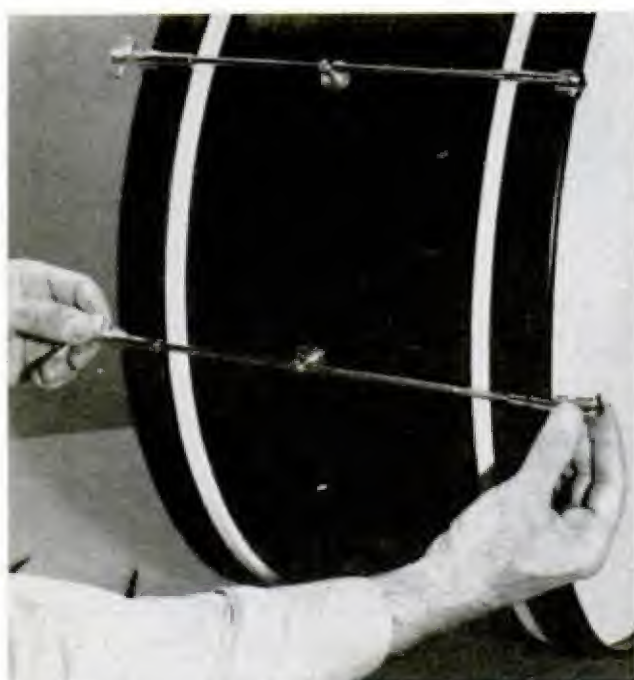
6 MOVABLE BANDS, which are part of drum, are permanently fastened with screws from inside



7 ANGLE BRACKETS ARE ATTACHED to be flush with shell's top. Tabletop is $\frac{1}{2}$ in. below rim



8 TOP BAND is positioned on the drum so that it will support the top hoop $\frac{1}{2}$ in. above the laminate-covered tabletop



9 TOP AND BOTTOM HOOPS will be held tightly against bands when drum clamps are replaced

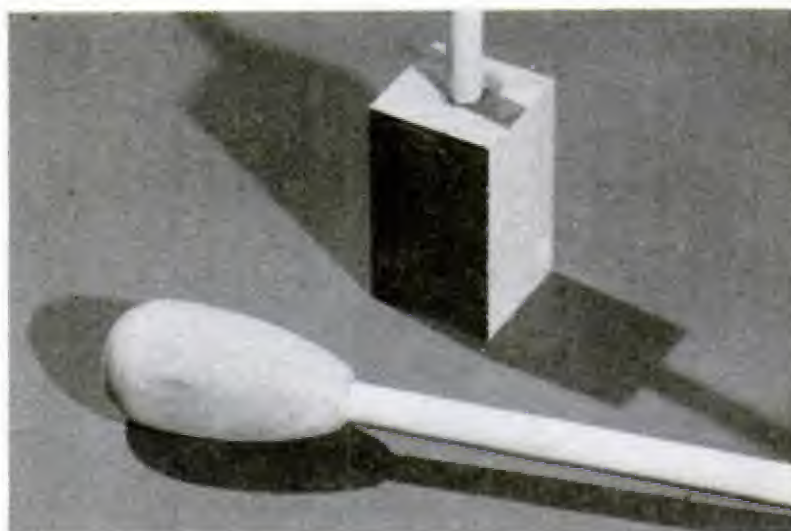
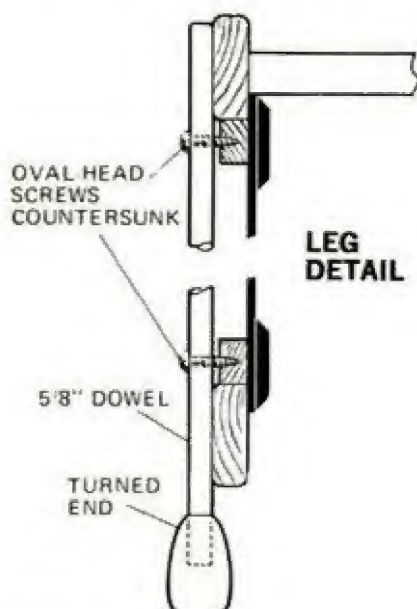
strip it down as far as you can go so you can do a thorough job of it. The typical parts—shell, hoops, bands and clamps—come apart easily.

Fir plywood and laminate top

The tabletop is made of $\frac{1}{2}$ -in. fir plywood cut about $\frac{1}{16}$ in. short of the inside diameter of the shell. Although your drum may seem to be perfectly circular, it may not be. You can check this out by tracing the shape of the shell onto a piece of cardboard and carefully cutting it out.

Test fit this pattern on the shell in varying positions. If the pattern indicates there are no discrepancies you can proceed to cut the wood perfectly round with a sabre saw guided with a pivoting jig as shown. If you discover the shell to be slightly out of round, you'll have to cut the top freehand

(Please turn to page 200)



10 FOR DRUMSTICK LEGS bore holes in $1\frac{1}{2}$ -in.-sq. blocks, turn blocks to shape and glue to ends of $\frac{3}{8}$ -in. dowels

POPULAR MECHANICS



Today, a man needs a good reason to walk a mile.

Start walking.



Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

25 mg. "tar," 1.6 mg. nicotine av. per cigarette, FTC Report AUG. '72.



YOU CAN BUY a conventional 30-gal. fish tank with stand for about what it will cost to build this beauty, but that's what you'll have—a conventional-looking aquarium.

Not so with this bubble pond. It's as different and unconventional as you'll find. Resembling a king-size salad bowl, it consists of a 30-in. diameter plastic bubble you buy and cradle in a simple half-lapped stand. When viewed from certain angles, the curved sides of the bubble magnify and produce weird and unusual effects that are fascinating to watch while the fish are swimming around a cascading waterfall.

The bubble comes with the edge

and outside edges of the lip by rubbing them lightly with the sanding block held at a 45° angle. Then rinse away any grit that may be clinging to the bubble by flushing the area with water and by swabbing it lightly with a wet sponge. Your bubble is now ready for mounting on a stand.

I made the stand of 5/4 x 10-in. premium-quality redwood and later finished it to look like walnut. The two legs of the stand are identical except for the inter-lapping notches. Lay out the pattern for the legs on cardboard, making the curve match the bubble. Nominally, this curve will be the same as the diameter of the bubble (15-in. radius) so you can use the

A \$50 aquarium that's really different

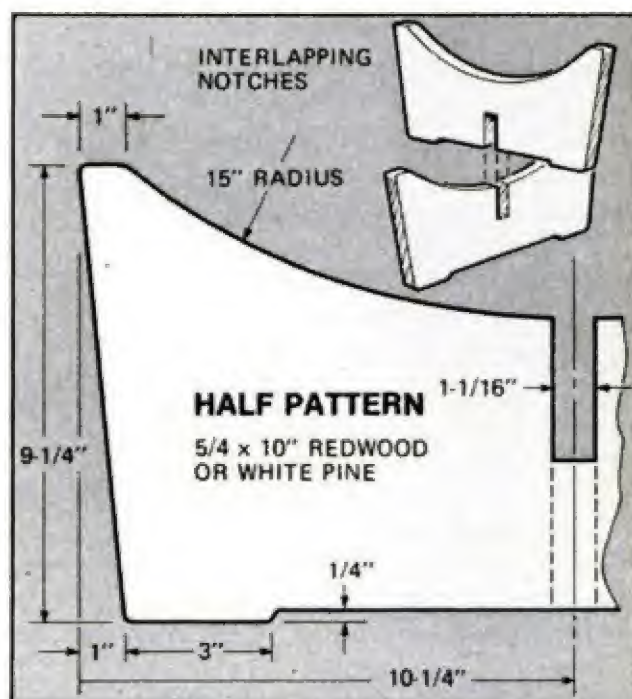
By **RONALD KONIECZYNSKI**

Technical art by **Fred L. Wolff**

trimmed and partially sanded so that it requires final finishing with fine sandpaper (150-grit followed by 220-grit) wrapped around a wood block. A sturdy cardboard box, about 18 in. square with the open end up and covered with a soft throw rug, makes a good marproof holder for your bubble while you work on it.

To get a professional-looking frosted finish on the lip, your sanding strokes should follow the curve of the bubble's rim. Your arm will sweep in a natural arc if you reach over the bubble and sand the far edge from the inside. Sand lightly and rapidly, changing sandpaper frequently. This job should take no more than 30 minutes.

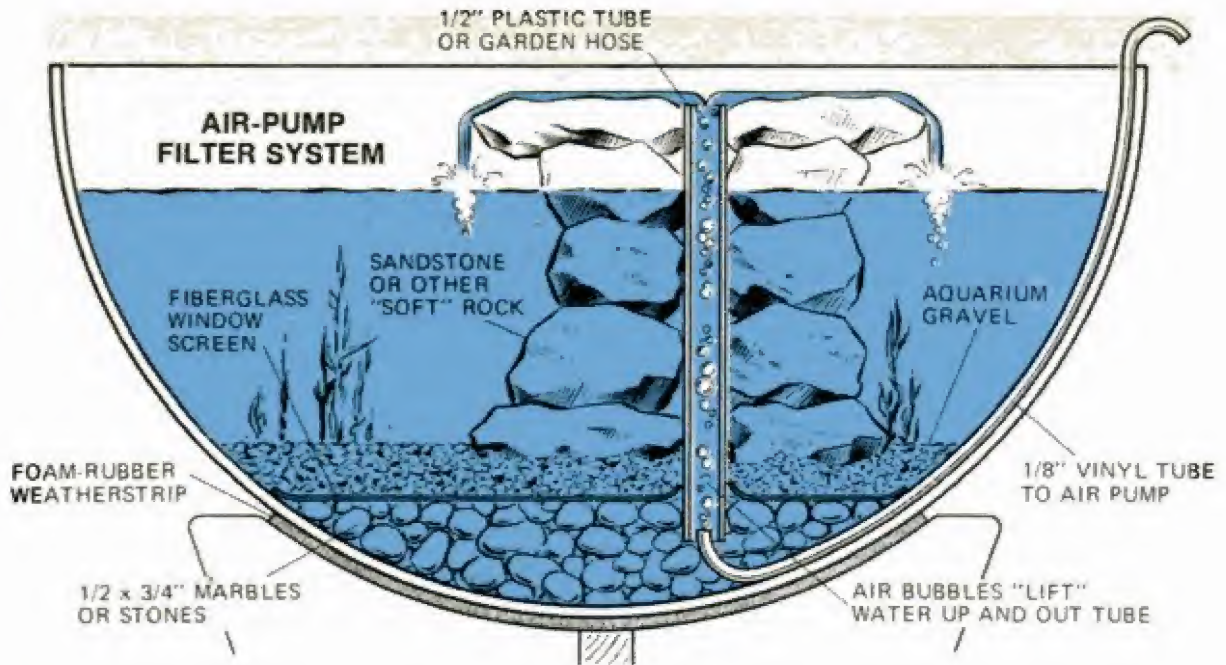
When you are satisfied with the finish, break the sharp corners on both the inside



bubble's lip to trace the curve on your cardboard.

After you cut out the template, check it to see how well it fits the bubble. While a perfect fit is not critical, there should be no more than a 1/16-in. gap at any point.

Next, trace the pattern for both legs on the wood; saw out and round all edges and corners before cutting the notches. The notches are formed by making two straight saw cuts and breaking out the wood between with a chisel. After notching, finish-sand the flat faces prior to assembly. Notching is done most accurately on a table saw, running up the blade as high as possible and feeding the work with the saw's miter gauge. Two parallel saw cuts will result in both members of the cradle. However, you must remember to



stop the cut short of its mark on the top side of the work to allow for the curvature of the blade which makes a deeper cut on the underside of the work. A handsaw is used to finish and even up the cuts.

If the notches are a snug fit, you won't need glue—simply slide one into the other. If the notches happen to fit loosely, use some resorcinol resin glue to help fill the gaps and strengthen the joint. Wipe off any excess glue right away with a slightly damp rag.

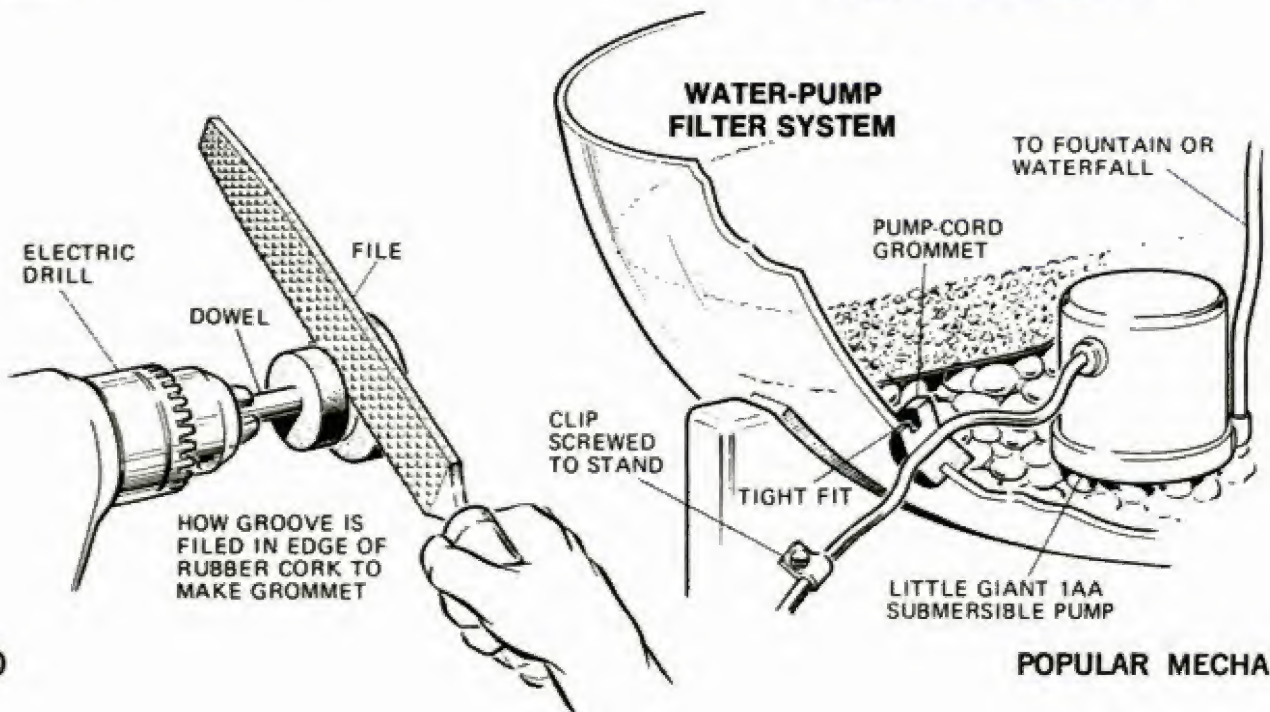
Fruitwood oil stain produces a handsome walnut finish when applied to redwood. After the stain is dry, apply three coats of satin-finish urethane varnish. Sand lightly with fine sandpaper between the second and third coat and burnish the latter coat with No. 00 steel wool after it is thoroughly dry. Finally, apply paste wax.

The bubble rests on $\frac{5}{16} \times \frac{3}{4}$ -in. sponge-rubber weatherstripping which has a self-stick backing. The self-stick side is placed up and its protective paper covering is left intact while the strip is cemented to the stand. Coat the strip with contact cement and press it in place while the cement is still tacky. This will give you time to shift the strip when centering it.

While the rubber strips are drying, you can go ahead and mount the bubble. The rim of the bubble must be parallel to the base of the stand because any slant will be obvious when the bubble is filled with water.

First, set the bubble in its wooden cradle on the floor where it will be used and shift its position until a level placed across the rim shows it to be level. Now mark the position of the bubble with respect to the

(Please turn to page 172)



Dodge makes pickup history.



The Club Cab. Our newest addition to the Dodge pickup line.

The exclusive DODGE CLUB CAB gives you an extra 34 cubic feet of storage space inside for the things you don't want to leave outside.



The extra carrying space behind the seats of every Dodge Club Cab means that when it rains, you store. This useful space is ideal for keeping valuable equipment secure, out of the way, and out of the weather. There's room for everything from tools to groceries to optional auxiliary jump seats. And Dodge does it all without

taking any room from the box. What's more, you can get that Club Cab with a full-sized pickup box into any standard 20-foot garage.

The Club Cab, like all Dodge Sweptline pickups, gives you front disc brakes, double-wall construction all around, and independent front suspension. You also get the new Electronic Ignition System for surer starts in any weather. This system is not affected by cold or rain. It eliminates points and condensers that wear out and is virtually maintenance-free. The Electronic Ignition... another example of how extra care in engineering makes a difference in Dodge... depend on it.



AGAIN THIS YEAR,

WHAT'S NEW IN PICKUPS COMES FROM DODGE...DEPEND ON IT.

FEBRUARY 1973

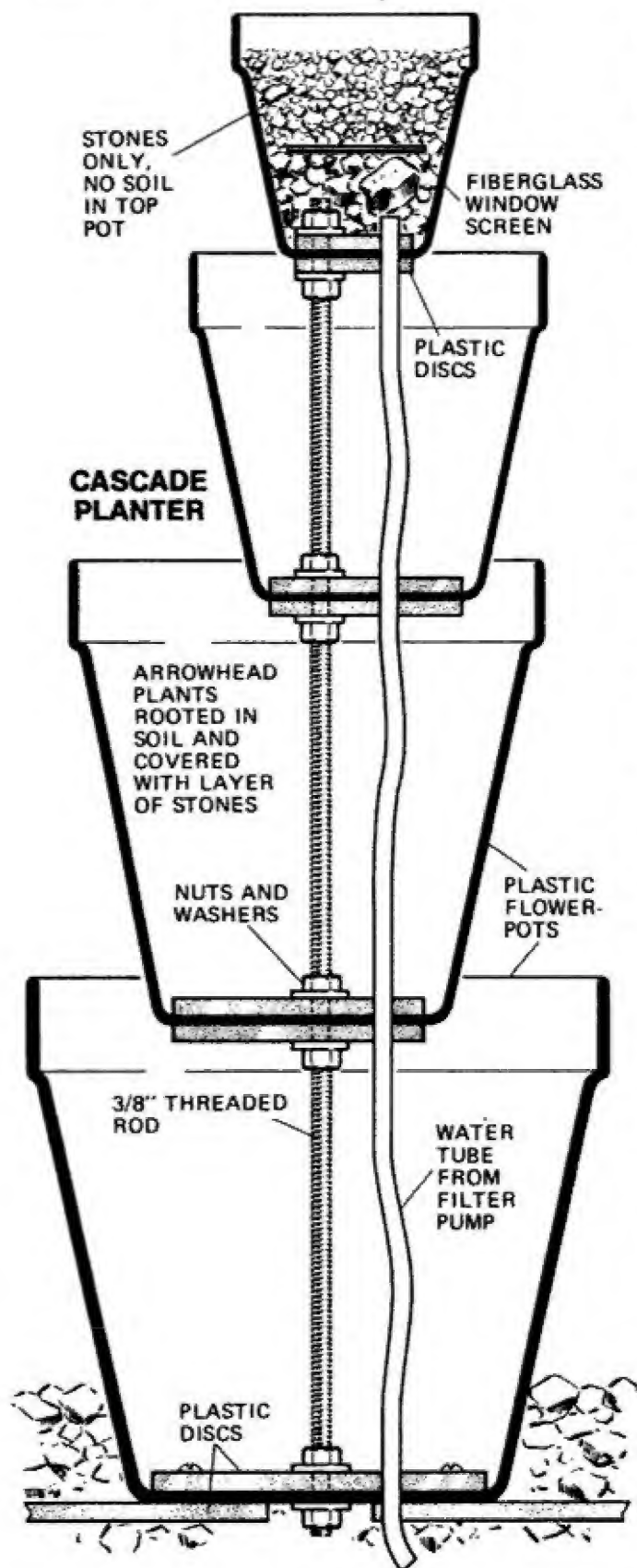
171

Illustration: 3/4 view of Club Cab by Tom Ichniowski

\$50 AQUARIUM

(Continued from page 170)

cradle by sticking pieces of masking tape on the inside and in line with the legs. Lift the bubble, remove the protective paper from the weatherstripping and place the plastic shell back in the cradle as it was.



Finally, fill the bubble with water to weight it and bring it firmly against the sticky strips.

You have a choice of two filter systems. One employs an air pump located outside the bubble; the other a submersible water pump placed in the middle of the bubble. Each system has its advantages; the clear vinyl tubing used with the air pump is inconspicuous and doesn't need hiding, whereas the electric cord to the water pump is not easily concealed and requires running it out a hole in the bottom of the bubble. Boring a hole in the plastic for a watertight grommet is not difficult if you use a saw-type hole cutter in a slow-speed drill and exert only light pressure.

The drawings show two ways of creating planter islands in the center of your bubble.


The cascade planter at left consists of a tier of plastic flowerpots joined by a threaded rod. The lower end of the rod is attached to a plastic disc, which in turn is weighted with stones and aquarium gravel. Here water bubbles up through the stones in the top pot and cascades from pot to pot.

The arrowhead plants in the two lower pots are rooted in soil that is covered by a layer of stones to keep the dirt from washing out. The vine in the top pot is bedded directly in the stones without dirt and thrives on the continuously circulating water. Discs of plastic or hardboard are placed inside and under each pot and used to clamp the pots to the threaded rod with nuts and washers. The tubing from the filter pump is snaked up through holes in pots and the discs. A disc of fiberglass window screen in the top pot deflects the water and prevents it from dislodging the stones.

When filled with water, your bubble pond will weigh up to 300 lbs. so decide on a permanent location before you fill it. Moving it afterward would surely be difficult.

Follow the usual rules in maintaining an aquarium: Avoid overstocking with fish and overfeeding. A couple dozen small goldfish and a dime-store turtle or two make a fine beginning. Turtles need a rock or two to climb onto.

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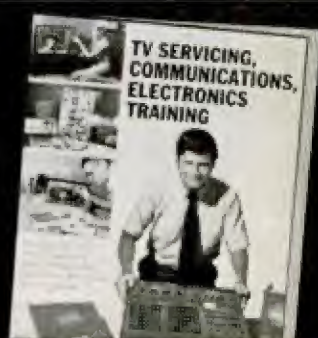
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PICTURE FRAMES

(Continued from page 77)

thumb (and in my opinion a correct one) is that *any picture will look good—in any room decor—if properly framed.*

How to mat. In general, delicate prints, watercolors and fine reproductions are enhanced by the addition of a mat. Mat board comes in 30x40-in. sheets in a variety of colors and textures from smooth to grass cloth in shiny or dull finish. If you decide that your picture needs a mat, it is the first step in picture framing because its outside dimensions will determine frame measurements.

Two "musts" when cutting a mat: First, the bottom horizontal is *always* slightly wider than the top horizontal and the verticals. The average mat is usually 3 in.

wide at sides and top and 3½ in. wide at bottom. Second, the cutout should always be made with a bevel cut as shown on page 77. The sloped edge enhances the picture and also visually minimizes any minor irregularities if your cutting tool should wander from the straightedge even slightly.

Measure the picture to be framed and transfer the marks to the mat board. Make the cutout as shown, then decide the mat's width. Don't forget to add ½ in. in height and width to allow for the portion which will be in the ¼-in. rabbet. Cut a backing board, tape the print to its center and secure the mat.

As a rule, matted pictures are covered with nonreflecting glass. When you buy picture glass, make certain it is clear and free of any bubbles or waves. And, be-

Picture-framing tools and supplies



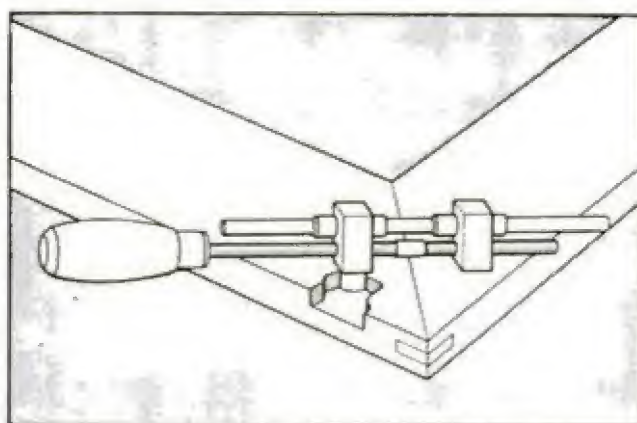
TOOLS YOU'LL NEED include a backsaw, miterbox, glass cutter, combination square, utility knife, corner clamp, ruler, pencils, nailset and light hammer. An electric drill, optional, is a desirable addition



BUILDING AND FINISHING SUPPLIES: White glue, oil (or water) stain, varnish, assorted brushes (bristle for oil paints, nylon for latex), filler, paint, clear spray finish, sandpaper, cheesecloth, Scotch connectors, picture hangers, brads, picture wire and, for "antiquing," tubes of burnt umber and black



GOOD VARIETY OF CLAMPS is nice to have around; they're a sound investment if you are planning to make a lot of frames. Clamps shown here are spring-type (center), three-way edging, handscrew, web and a pair of miter clamps—which hold a frame square



MITER CLAMPS are designed for use on flat stock (S4S). You must drill two ⅝-in. holes in back of the frame for seating each clamp. All clamps shown here are available at hardware suppliers. If you cannot find one locally, write to Adjustable Clamp Co., 422 North Ashland Ave., Chicago, Ill. 60622



MAT CUTOUT should be made with slight bevel. The cutter shown lets you do this accurately and quickly



CUTTER, called a Dexter Mat Cutter, costs about \$6 at artists' supplies stores. It's made by the Russell Harrington Cutlery Co., Southbridge, Mass. 01550

cause picture glass is particularly fragile, handle it with care. Work on a clean, flat surface; preferably your workbench after it has been covered with cardboard. Take accurate measurements of the frame's rabbet opening, and don't forget to sub-

tract $\frac{1}{8}$ in. in length and width so that the glass won't shatter when you insert it. (If you prefer, let glazier do the cutting.)

Making a picture frame. Most frames have a rabbet to contain the picture

[*\(Please turn to page 180\)*](#)

Making a picture frame



TO ASSEMBLE SUBFRAME, use glue and Skotch connectors on the back side. If subframe will be seen from the front, use mitered (instead of butt) joints



AFTER ASSEMBLY, drive in two finishing nails at each corner. Allow the nails to protrude $\frac{1}{16}$ in. above the surface and then set them $\frac{1}{16}$ in. deep



CUT FRONT-FRAME MOLDING using a miterbox and backsaw. For stability, clamp miterbox to workbench



FASTEN FRONT FRAME TO SUBFRAME with glue and suitably sized brads. Molding overhang forms rabbet

Finishing tips and hints



TO "ANTIQUE" STAINED FRAME, darken the corners with burnt umber. Use a clean cheesecloth to blend the umber carefully into the adjacent stained wood



TO COLOR-TONE PAINTED FRAME, apply a wash of second color (above, blue over white). After a few minutes, wipe off the color with a clean cheesecloth

PICTURE FRAMES

(Continued from page 179)

(all of those shown do). In some cases, a single molding such as back band—used on a simple poster—does the job. But for more sophisticated frames, you make a two-piece frame consisting of a back (subframe) and front frame (with an opening $\frac{1}{2}$ in. less in width and height to create the $\frac{1}{4}$ -in.-wide rabbet).

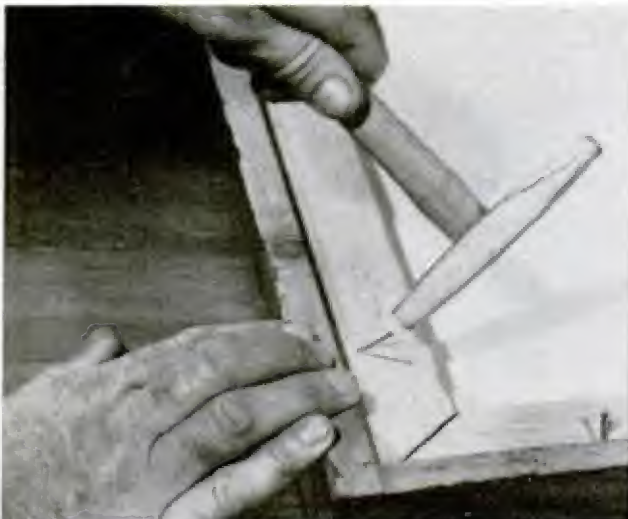
A subframe can be joined using simple butt joints if it will be fully covered by

the front frame, Bainbridge board or cloth. If the subframe will be in view, however, miter-cut these corners as well as the moldings.

Use a miterbox to make the cuts and assemble the frames using a corner clamp as shown in photos. The clamp is fastened to the workbench and when the moldings are secured in its jaws, they're held square while you do the gluing and nailing. When all four sides are assembled, check the frame with your square and temporarily

(Please turn to page 182)

Mounting and hanging pictures



OIL PAINTING ON STRETCHERS is held in frame by driving 4d nails through stretchers into the frame



MOUNTED PRINTS (on cardboard or hardboard) are secured in the rabbet with eight brads (two per side)

Want a job doing what comes naturally? Take this test.



A



B



C



D

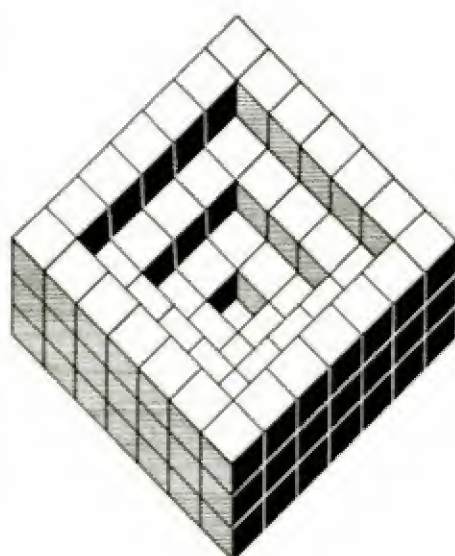


E

Think you're a "natural" technician? Then you should be a lot better than average at spotting the differences be-

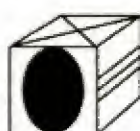
tween similar objects. For example, which part, A, B, C, D, or E has a visible defect?

Answer: D



Here's a tougher one. Give us the right total of cubes in this figure. You'll be proving to yourself you have the kind of clear head and mechanical aptitude that really count for something in the Air Force.

Answer: 112



A



B



C



D

Good imagination and deductive powers? They'll help you fly through the Air Force's many types of advanced technical training. Think—which ones

of cubes A, B, C, or D could be the same cube as the one on the left, only turned?

Answer: A, B, C, D

Illustrations Courtesy of Arco Publishing Co., Inc.

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INSTALL PICTURE WIRE below top of frame so that picture hanger on wall will not show. A simple jig assures that wire length is on the money every time

PICTURE-WIRE JIG is quickly fashioned from scrap. Distance A must suit frame to be fitted with wire



STRIATING "TOOL," conceived by author, consists of 8d finishing nails driven through $\frac{3}{4}$ -in. pine strip

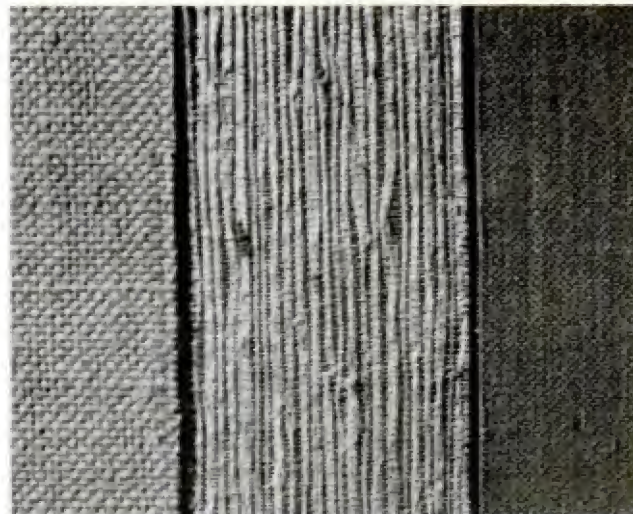
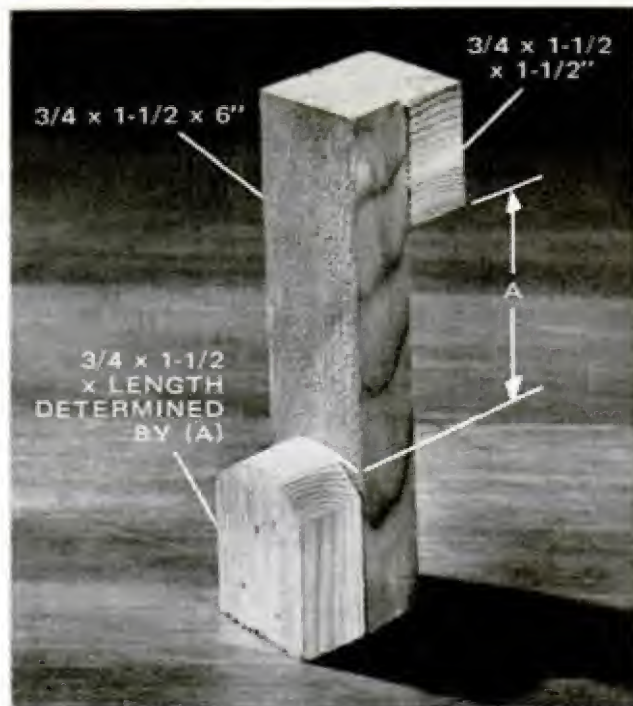
PICTURE FRAMES

(Continued from page 180)

tack two diagonals across the frame back to hold it square while the glue dries. Finally, set all nails $\frac{1}{16}$ in. below the surface, fill and sand.

Next, attach the front frame to the subframe with glue and appropriate-size nails. When the glue is dry, sand frame well with a fine-grit sandpaper and dust it thoroughly before finishing.

Finishing a frame. There are three basic finishes you can use: natural, stained and painted. Materials are a matter of personal preference; oils or alkyds give you a longer time to work the finish (when rubbing off an antiquing wash, for example), but latex materials let you do the job a bit



TEXTURED BAINBRIDGE BOARD used on some frames in story (from left): burlap, grass cloth and linen

faster and with less cleanup to be done when you have completed the job.

Natural finish: Apply either thinned shellac or varnish. Allow to dry overnight, rub lightly with 4/0 steel wool, wipe off dust and apply a second, nonthinned coat of the same finish. After 24 hours, apply wax and buff to a sheen.

Stained finish. Apply a stain of your choice, allow it to set 15-20 minutes, then wipe off the excess. Let this dry at least 24 hours, then apply a coat of shellac thinned 50-50 with alcohol. Wait a day, then rub lightly with steel wool, dust and apply a finish coat of varnish.

"Antiqued" stain finish. Follow the same steps described above, but after staining apply burnt umber directly from the tube,

(Please turn to page 184)

HOW COULD YOU FORGET

MILT MARION?

1936 was a very good year for a race fan. The very first race on the famous Daytona Beach-Road Course was held.

The purse was 5,000 bucks, and lest you think this was a minor-league affair, remember the price of groceries in '36. This kind of important money attracted a pretty hot field, including: the Indy 500 winner, Bill Cummings; the dirt track champions Bob Sall, Doc Mackenzie and Ben Shaw; Major Goldie Gardner; the Collier brothers, Miles and Sam; and an obscure service station operator named Bill France.

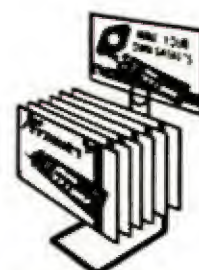
The winner? Good old boy Milt Marion, in a Ford V-8, the Permatex Special. (That France fellow was not only Milt's mechanic, but drove another Ford to fifth place.)

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Courtesy of Museum of Speed, Daytona Beach, Florida



PICTURE FRAMES

(Continued from page 182)

using a cheesecloth. Corners and crevices should appear darkest and the umber should be carefully blended to "disappear" as you work it toward the center. Then, you can proceed with finishing as indicated above.

Paint finish: Apply a wash-coat of shellac (thinned 50 percent with alcohol) and let it dry. Rub lightly with steel wool, dust and apply color of your choice. You can use oil-base enamel or, if you prefer, latex. The latter, though, should be followed with a coat of varnish. *Caution:* use *varnish only* over latex paint or the paint will lift off. As you prefer it, the varnish finish can range from dull to high gloss.

"Antiqued" paint finish: After applying the basic color, allow it to dry overnight. Then, mix a black paint with appropriate thinner to a *slightly heavier than water* consistency. Apply this wash to the frame,

Specific instructions for all frames shown start in the column at right and continue on pages 188, 189 and 190. Bold type at the start of each caption gives picture size; the number in parentheses refers to the source for the art in that frame. (See page 190.)

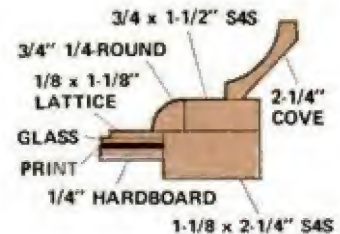
wait five minutes and wipe it off with a clean cloth. If desired, the antiquing can be done with another color instead of black. (For example, the frame surrounding the Tiger with Red Background (page 74) was finished by wiping orange over Chinese red.) Finally, proceed with an appropriate clear finish.

In general, when limited quantities will be needed, I've found that spray varnishes, lacquers and the like are easier to use than their brush-on counterparts. They eliminate a great deal of clean-up time and they set faster, which means that there's less time for dust to settle on your new frame during the drying time.

Hanging pictures. The easiest way to hang a picture is to use two screw eyes no longer than three-quarters of frame's thickness. Insert them about a quarter of the distance from top to bottom of the frame. Attach picture wire as shown and the picture is ready to hang. To keep picture from tilting, use a pair of picture hooks on the wall—spaced 6 in. or so apart—instead of just one. Make certain that the screw eyes, wire and hooks are strong

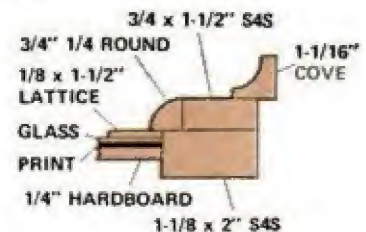
(Please turn to page 188)

On the cover



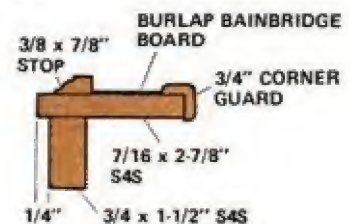
24x36 in. (1). Assemble subframe using the dimensioned stock shown. Cut and fit all moldings, and temporarily tack them in position. When you're satisfied with fit, remove moldings from the subframe. Striate the quarter-round and cove molds (see page 182), sand thoroughly and wipe off dust. Stain moldings dark walnut, let them dry; then finish with varnish. Seal the lattice and subframe with shellac wash. Apply charcoal gray latex paint to lattice and dark green (latex) to subframe. When parts are dry, permanently assemble the frame using glue and brads

Frame on page 73

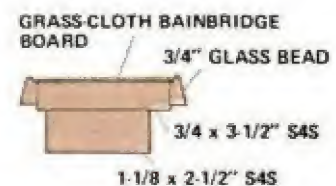


18x36 in. (2). Follow construction details above. Finishing details are also the same as above, except for a driftwood stain on moldings and dark blue latex on subframe

Frames on page 74



22x28 in. (3). Assemble the subframe and glue on white burlap board. Cut and fit moldings, remove and seal with shellac. Apply white latex, let it dry, antique with pink latex. Varnish and permanently assemble



22x28 in. (3). Assemble the subframe, then glue and tack 3/4-in. stock to the frame. Cut and temporarily tack bead moldings in position to check fit, then remove. Apply sandalwood grass-cloth board to frame, stain and varnish moldings, then permanently attach them to frame's inside and outside edges as shown

The day Bill told off his boss



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PM-76

PICTURE FRAMES

(Continued from page 184)

enough to hold the weight of the picture.

Instructions for all of the frames shown in the photos are given. Bold type at the



1-3/8" CLAMSHELL STOP



1-1/16 x 1-3/16" S4S

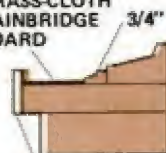
18x28 in. including mat (4). Assemble frame; sand, dust and apply a driftwood stain. After 15 minutes, wipe off the excess.

When dry, size the frame with

shellac, brush on a yellow latex paint, wait 5 minutes and wipe off frame. Finish frame with varnish



GRASS-CLOTH BAINBRIDGE BOARD



3/4" BASE CAP

1-5/8" DRIP CAP

3/4 x 3-15/16" S4S

1/4 x 1-1/8" LATTICE

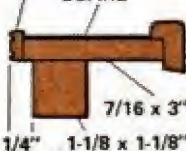
1-1/8 x 3-1/2" S4S

22x28 in. (3). Assemble subframe and 3/4-in. stock. Cut, fit and temporarily assemble the moldings; then remove them. Cover frame with tan grass-cloth Bainbridge board. Striate and sand the drip cap, then apply a dark pine stain. Seal the lattice with a shellac wash; paint it mustard yellow. Finish moldings with varnish; permanently attach them to frame



5/8" SHELF EDGE

BURLAP BAINBRIDGE BOARD



BACK BAND

7/16 x 3" S4S

1/4" 1-1/8 x 1-1/8" S4S

22x28 in. (3). Assemble subframe and 7/16-in. stock.

Cut and fit moldings, then remove. Size the frame with thinned shellac, allow it to dry, then cover it with gold burlap board. Seal moldings with shellac and apply Chinese red latex. When dry, antique with yellow latex, tinted slightly with black. Varnish moldings and permanently attach them to the frame.



1-5/8" PICTURE MOLD

1/4 x 1-1/8" LATTICE



3/4 x 3/4" S4S

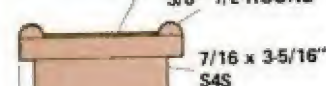
18x32 in. including mat (4). Assemble all parts and size with thinned shellac. Finish the frame using buttercup yellow and chocolate brown on picture molding and lattice, respectively. When dry, antique the yellow with an avocado green and varnish frame.

Frames on page 75



BURLAP BAINBRIDGE BOARD

3/8" 1/2-ROUND



7/16 x 3-5/16" S4S

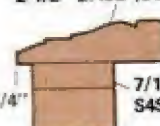
1/4"

1-1/8 x 2-3/4" S4S

22x28 in. (3). Assemble the subframe and 7/16-in. stock. Glue rust-colored burlap board to the frame, using brads where necessary. Miter cut and fit half-round moldings, then remove them. Size moldings with thinned shellac, then apply white latex paint. When dry, finish with varnish and attach moldings



2-1/2" BASE (COLONIAL)



1/4"

7/16 x 1-3/8" S4S

3/4 x 1-3/8" S4S

22x28 in. (3). Assemble the subframe, attach front-frame moldings (miter corners). Seal wood with a thinned shellac. Brush on colonial blue latex and let it dry. Next, apply a slightly thinned white latex and, after five minutes, wipe it off with clean cloth. When completely dry, finish wood with varnish



5/8" COVE



7/16 x 1-7/8" S4S

3/4 x 1-1/2" S4S

15x20 in. (5). Glue print to 1/4-in. hardboard. Assemble frame and size it with shellac. Using latex paints, brush on olive green, allow it to dry, then antique with thinned red latex paint. Use varnish as a finish and picture glass to protect the print



1-5/8" MULLION CASING



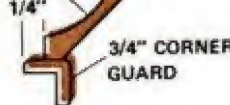
7/16 x 3/4" S4S

15x21 in. (6). Assemble the subframe and mullion casing. Brush on pine stain, wait 15 minutes and wipe off excess. Antique corners with burnt umber; allow 24 hours to dry. Finish the frame with lacquer



2-1/2" COVE

1/4"



3/4" CORNER GUARD

21x27 in. including mat (4).

Assemble the frame from moldings, using miter cuts at all corners. Size the frame with a thinned shellac and allow it to dry. Apply a mustard yellow latex paint to the liner (corner guard) and use avocado green latex paint on the cove. Apply varnish to the frame for a finish

start of each caption refers to the picture's size. Following the size is a number in parentheses that refers to a where-to-buy source listed on page 190. ★ ★ ★

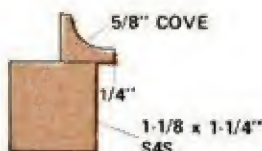
Instructions for more frames and a list of where-to-buy sources appear on page 190.

Frames on page 76



23x28 in. including mat (4).

Because the subframe is visible, use miter joints throughout. After assembling frame, apply dark walnut stain to subframe. Next, seal entire frame with thinned shellac. Paint crown molding and bead (liner) with white latex and let it dry. Then apply thinned orange paint to crown only, wait five minutes, wipe. When dry, spray on varnish



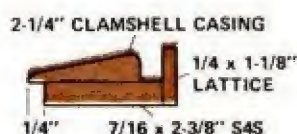
22x28 in. (3). Assemble the frame using miters on all corners. Size entire frame with a thinned shellac and

set it aside to dry. Next, using latex paints, apply a dark yellow to the cove molding and a flat black to the subframe. When dry, antique cove molding with a thinned black. Finally, varnish all parts



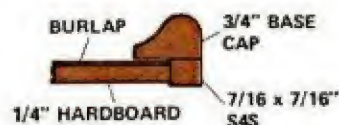
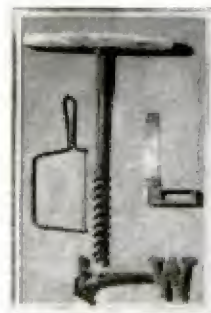
17 1/2 x 23 1/2 in. (3). Assemble frame, fill holes and sand thoroughly. Apply a walnut stain, wait 15 minutes and

wipe off. Finish with two coats of a semigloss lacquer. Rub lightly with 4/0 steel wool between coats. Wait 24 hours; rub on paste wax and buff to sheen



22x28 in. (3). Assemble the frame as shown above. Set

all nails, fill nail holes and thoroughly sand wood. Size with thin shellac, allow to dry. Brush on dark green latex paint and let dry. Antique frame with thinned black latex. When dry, finish with varnish

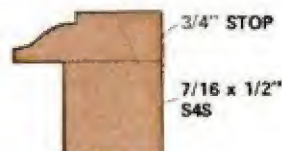


15x22 in. (framing a collection). Arrange objects to determine size of 1/4-in. hardboard. Glue red burlap to hardboard using staples at edges. Assemble the frame, striate wood moldings

and sand. Apply driftwood stain, then wait 15 minutes and wipe off excess. When dry, apply lacquer. To hold objects, drill holes through board (bracketing a part of each object). Run thin copper wire around objects and through holes; knot wire on back of board. Wire each object in at least two places.



8x10 in. (7). Simple object, extra simple frame; assemble it with glue and brads at mitered corners. Apply pine stain, antique with burnt umber and finish with lacquer. Back up the print with cardboard



6 1/2 x 9 1/2 in. (7). Assemble the subframe and add stop molding at front. Size all wood with shellac and allow to dry. Sand it lightly and brush with avocado green latex paint. Let dry, finish with varnish. Print should be backed with cardboard and, if desired, covered with glass

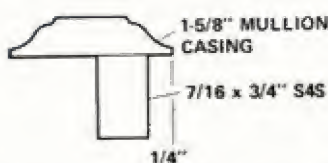


18x29 in. including mat (4). Assemble the subframe and frame using stock shown. Fill holes, sand, seal with shellac wash.

Apply dark red latex paint, allow to dry and then antique with black-latex wash. Finish with two coats of varnish, protect the woodcut with picture glass

PICTURE FRAMES

(Continued from page 189)

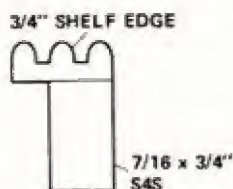


12x16½ in. (8). Assemble the frame, sand and seal with a shellac wash. Brush on reddish-orange latex, let dry, antique lightly with burnt-umber wash. Varnish when dry; use hardboard backing, glass to protect print



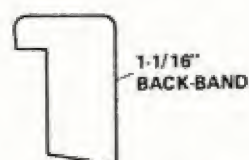
19x28 in. (9). Glue poster to piece of ¼-in. hardboard cut to the same size. Use a straight-edge and clean cloth to assure

that the poster will be perfectly flat and that there will be no air bubbles under it. Assemble the frame directly to hardboard and seal it with thinned shellac. Apply mustard yellow latex paint to the frame, let this dry and antique it with burnt-umber wash. Use this same wash to slightly antique the print around its edges. For a finish, apply a spray-type varnish (dull) to the frame as well as the poster



12x16 in. (8A). Using a white glue, affix poster to same-size piece of hardboard. Assemble

frame and size with thinned shellac. Brush on orange semigloss enamel and allow to dry overnight. If desired, frame can be antiqued with burnt-umber wash, but make sure you follow this with a varnish finish



8x10 in. (7). Assemble back-band frame with mitered corners, seal it with thinned shellac, then finish with bright green enamel. Back print with cardboard

12x16 in. (8B). This first-performance opera poster has the same frame construction and finish as that used for Reward poster. Glue reproduction to hardboard and cover poster with picture glass if desired

Where-to-buy-it information

Note: Send a check or money order; allow two to three weeks for delivery.

1. Print *Christina's World* (Wyeth), \$8. The Museum of Modern Art, Publication Sales, 11 West 53 St., New York, N.Y. 10019. (New York City residents add 53 cents sales tax.)

2. Print *Northern Point* (Wyeth), \$16. For nearest source, write New York Graphic Society, Print Dept. PM, 140 Greenwich Ave., Greenwich, Conn. 06830. (Nine other Wyeth prints are also available.)

3. Oil painting reproductions: varnished canvas on stretchers, \$10; rolled canvas, \$5 ppd. Specify name of reproduction and artist when ordering. The Donald Art Co., Dept. PM, 90 South Ridge St., Port Chester, N.Y. 10574.

4. Original woodcuts and signed lithos, \$30 and up. Specify name of work and artist. Associated American Artists, Dept. PM, 663 Fifth Ave., New York, N.Y. 10022.

5. World War II tank prints, four styles available, \$3.25 each or four for \$9.95 ppd. Mar-Star Enterprises, Box 724, Wheaton, Ill. 60187.

6. Pirate treasure map, \$3.95 ppd. Virgil Hammonds, 23735 Donald-C, East Detroit, Mich. 48201.

7. *Reward, Join or Die, Stamp Act* reproductions, 50 cents each or three for \$1.25 ppd. Hinsdale Craftsman, Box 282, Elmont, N.Y. 11003.

8. Temple rubbing, 10 styles available, \$3 each or two for \$5 ppd. (8A). 1911 Packard advertisement, 10 old-time posters available, \$1 each or five for \$3 ppd. (8B). First-performance opera posters, 12 styles available, \$1.25 each or 12 for \$11 ppd. Fiesta Arts, Inc., Greenvale, N.Y. 11548. Free brochure on all styles available.

9. Chaplin poster; limited quantity available. Write Marboro Books, Dept. PM, 205 Moonachie Rd., N.J. 07074, for poster catalog listing 350 styles available and prices.

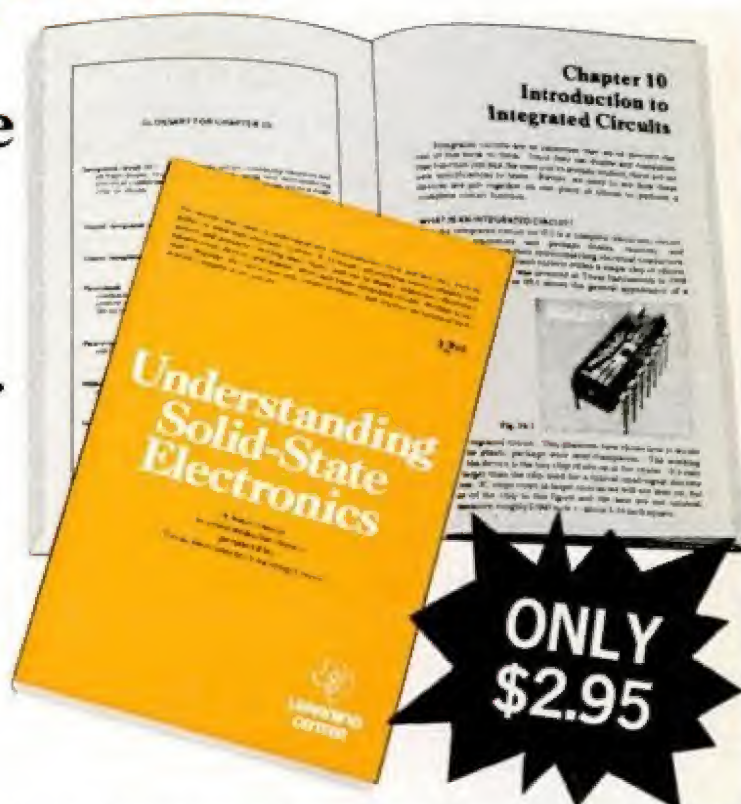
Bainbridge board, textured and smooth. Available at art-supply and department stores, or write Charles T. Bainbridge's Sons, Dept. PM, 20 Cumberland St., Brooklyn, N.Y. 11205.

Frame-making tools (shown on page 178). Available at hardware suppliers or write Stanley Tools Div., The Stanley Works, 195 Lake St., New Britain, Conn. 06050, for nearest source.

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TEXAS INSTRUMENTS
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ELECTRONIC CALCULATORS

(Continued from page 90)

preset the switch for. That's handy for dollars and cents calculations, among others.

If there's a decimal point and no switch (or an "F" position on the decimal selector), the unit has *floating decimals*, which automatically drop off all zeroes beyond the decimal point, and move the remaining figures all the way to the right. Most fixed-decimal machines have floating-decimal inputs, so you can multiply a three-digit and a four-digit number to get a two-digit result; but check: A few units (like the \$99 Aries and \$200 MITS kits) have fixed-decimal inputs, too.

Fixed-decimal machines usually just drop away any digits beyond the pre-

Memories are found on some more elaborate calculators, usually from about \$150 up.

lected number; set to two places, they render both 0.210 and 0.219 as just, plain "0.21." More sophisticated units round off numbers whose first suppressed digit is four or lower, and round up one digit if the digit suppressed is five or more.

Most calculators *underflow*: if an answer has more digits than will fit on the display, the last and least important digit is dropped and (usually) some sort of indicator tells how many digits were dropped. Some units show all the significant digits the display will hold, then display the remaining digits when you press a special *overflow* key.

The *clear key* wipes out any figures or answers in the machine (most machines also clear themselves when you turn them on, and when you enter a new figure after a multiplication or division); but in case you make a false entry in the middle of a long problem, most calculators have keys (CE, CI, CD or CL \times) which erase only the figure on the display, but leave any previous subtotals intact.

Most calculator operations are done in "algebraic order": Just punch the keys in the order you'd use to write the equation on paper ($2 \times 3 = 6$, for example). But on calculators with combination "+=" keys, there's an exception: numbers being subtracted are *followed* by a minus sign, not

preceded by it as in normal figuring. If you don't use your calculator often, this can get confusing. Machines with separate "=" keys use normal order and are more versatile, too. They clear automatically if you enter a number after any completed operation, and (if they have any sign-change or "+/-" key) let you multiply, divide, add and subtract negative numbers as well as positive ones.

Chain calculations are possible with all calculators. You can run through an hour-long string of operations ($6 \times 5 \div 3.2 + 6.6 \dots$) without touching the equals key till the chain is complete; and every time you touch a function key, you see the subtotal of the previous operation. If you do push the equals key ahead of time, just enter the next function key to continue the chain (that is, you can key either " $2 \times 3 \div 5 =$ " or " $2 \times 3 = 6 \div 5 =$ " and still get the same result: 1.2). Again, subtraction is different: If you have a combination "+=" key, you must total each transaction before subtracting the next element.

A key or switch marked "K" lets you multiply or divide by *constants* without re-entering the constant each time. To multiply 2, 3 and 4 by 3.14159, you need only do the whole multiplication the first time, with the constant switch on. After that, each time you enter a new number and press the equals key, that number is multiplied by the constant.

Memories are found on some more elaborate calculators, usually from about \$150 or so up. In their simplest form, they can store any number on the display—but entering a new number wipes out the old one. Such memories are useful for constants you don't want to use in every operation, or to store subtotals for later reference. More common memories have separate "M+" and "M—" keys that let you add to or subtract from the memory total, and buttons that clear the memory without affecting the main register.

On expensive office machines, you may even find accumulative (or "sigma") memories which store the results of a series of independent, nonchain multiplications and divisions to provide a grand total. And you may find "item count" memories which count how many items have been added or subtracted (handy for finding your place when adding up a list) or how many multiplications and divisions have been carried out. ★★

WARNING ON THE WINDSHIELD

(Continued from page 79)

rate when it slows down. All the driver must do is use the lines like a gunsight, positioning the car in front between them.

"When we announced that we'd worked out how to project these two separate items of information onto windshields," the Road Research Laboratory man said, "we were urged to project other information about the car's performance there. But we've resisted doing this because it seems more sensible to keep to a minimum the information we put before drivers. In fact, we'd like to convey only one other piece of information through the head-up system—and that's a general warning, a red spot of light, probably, that'll flash into the windshield the moment anything in the car goes wrong.

"We think that in the car of the future the instrument cluster will be out of sight of the driver altogether, possibly tucked away in a console with a lid on it. He'll only need to check the instruments when the general warning light flashes and he pulls to the side of the road."

What does driving with a head-up speedometer feel like? "At first you're struck by the fact that for the first time you really do know at any given moment exactly how fast you're going," one test driver commented. "Then, when you've driven for several days with your speed always projected in your field of vision, you stop thinking about it. All you're aware of is that after a long drive you feel less tired, more relaxed than you used to."

Numerals indicating a car's speed will be projected in shocking pink—which to totally color-blind drivers will appear light gray. Antitailgating sight lines will be bright yellow, the trouble warning light red. The only adjustment in the system will be one that raises and lowers projected images for different-height drivers. Sliding the driving seat back and forth won't alter the motorist's position in relation to the antitailgating lines enough to matter.

The British aircraft industry is installing a variation of the system in commercial planes. On the road it will become more and more useful as automatic steering, transmissions, suspensions and sound insulation turn cars more and more into gliding, noiseless cocoons. ★ ★ ★

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SHORTWAVE ANTENNAS

(Continued from page 127)

horizontal; and above 25 MHz, wavelengths are short enough to allow such vertical antennas—stiff rods or wires called “whips.”

A different resonant principle applies here. The vertical aerial operates at one-fourth (a quarter) wavelength. The “other” quarter of the wave reflects on added metal elements called a *ground plane*. (Mother Earth doesn't much affect this kind of antenna.)

Calculating the resonant length of the whip resembles the procedure for long-wire antennas. Take the Citizens Band (CB) for example. Its center falls close to 27.1 MHz, where the wavelength is close to 11 meters. A quarter-wavelength figures out to 2.77 meters, or about 109 inches. In practice, though, various electrical effects make whip antennas a bit shorter—how much shorter depends on both the thickness of the whip (the thicker the shorter) and the material it's made from (fiberglass whips are shorter than aluminum).

The radial rods that form a ground plane for a vertical antenna are about as long as the whip. But sometimes, they aren't necessary: on a car, for example, the body metal, insulated from the whip, simulates a ground reflector.

You've seen plenty of quarter-wave vertical antennas. The whips on police cars, fire trucks and taxicabs are quarter-wave. A whip from 16 to 18 inches long resonates in the high VHF band. Longer whips, from 55 to 90 inches, counting a heavy spring at the bottom, cover the low VHF band from 30 to 50 MHz. Sometimes a loading coil at the bottom or in the center of the whip allows a short whip to cover these frequencies. Several modern two-way radio systems operate in the UHF, above 450 MHz; their whips are only 5 to 6 inches long.

You don't have to deface your car to mount a VHF antenna on it. Though some mobile antennas for shortwave require holes drilled in the car body, there are special mounts that clamp onto the bumper or trunk-edge instead. And few short vertical whips have magnetic bases, some with stick-on adhesive.

A plain wire download doesn't do for quarter-wave verticals. They take coaxial

cable. “Coax” comprises a wire surrounded by a layer of insulation, then a layer of metallic-braid shield, and covered by an insulated (usually vinyl) coating—similar to hi-fi cables, but thicker.

The cable end at the receiver terminates in some kind of coaxial connector. At the antenna, the center wire attaches to the bottom tip of the aerial whip; the braided shield goes to the ground plane—or to whatever serves as reflector for the quarter-wave vertical.

VHF listening

If your pleasure comes from police calls, fire runs, aircraft landing chatter and the like, you probably use a monitor receiver. If the station is not far away, you may get by with a cut-to-length bit of stiff wire fastened at the antenna screw on the back of the radio.

For more distance, use an outside antenna, which you can buy precut for whatever band you listen to most. Clamp it to a tail pipe mast or a special tower, or use a mounting that fits on the end of the house.

“Gain” antennas offer more sensitivity than a simple ground plane. Their designs build up a stronger resonance than a plain whip does. Extra-sensitive antennas may have whips tuned at some odd fraction—like $\frac{5}{8}$ ths of a wavelength. More than one whip may form an “array”—sometimes in X-shapes. And if you're interested in one station only, you can get an antenna that concentrates its gain in one direction.

Your window to shortwave listening opens only as wide as your antenna permits, so make sure the aerial fits the stations you want to hear. And if you need to, you can put up more than one. ★★★

I-C ENGINE

(Continued from page 105)

where the two chambers come together, a rich fuel/air mixture is formed. Ford is interested in this approach and has proposed a let's-swap-information arrangement with Honda. GM is also nibbling for a look at the Honda engine.

Ford's also looking at an idea that's supposed to be the supercure for making the i-c engine respectable again—the Proco engine. Proco's supposed to be the second-to-none solution to all problems

(Please turn to page 196)

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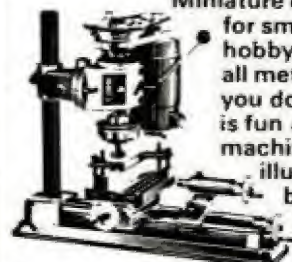


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I-C ENGINE

(Continued from page 194)

besetting i-c engine. According to some enthusiasts. Detroit says hogwash.

Proco stands for programmed combustion. Ford is credited with coming up with the name and is the leader in development of the engine. But Ford isn't the only company working on the idea. Chrysler has one too. Where Ford's going it alone, the Chrysler engine is a joint venture with Texaco.

Proco is a conventional internal-combustion engine with unconventional carburetion. The engine combines a stratified-charge combustion process, fuel injection direct to cylinders and electronic ignition.

The fuel injector sprays a precise amount of fuel into the cylinders. The swirl of fuel is caught in a current of air and stratified. The first shot of fuel burns rich, after which the burn becomes lean. The result is a marked reduction in the discharge of emissions—surpassing the clean air standards coming in 1975-76.

Proco has the distinction of being the only engine to receive an endorsement from a President of the United States. In a talk in Detroit two years ago, President Nixon hailed Proco as the auto industry's answer to Ivory Soap—99 44/100ths percent pure.

The folks at Ford have been trying to hand the bouquet back to the President ever since. They say Mr. Nixon was premature—by perhaps as much as 10 years.

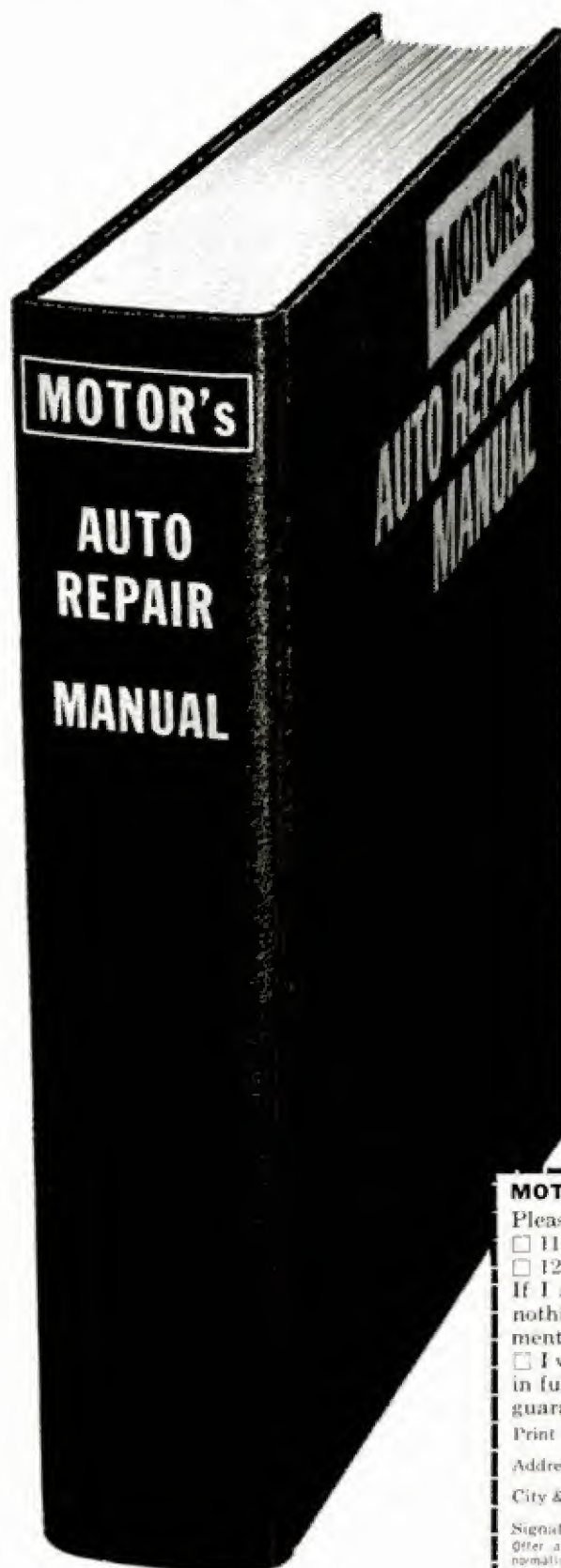
Ford has had trouble keeping the engine going on a test stand, let alone in a car. It has to maintain a crew of technicians on standby to keep Proco from puttering out. The company won't even say what the experimental version cost to build. The bill for just one part of the injection system ran \$15,000.

The most optimistic prediction by Ford on when the engine may be ready is an unenthusiastic, vague "sometime after 1976."

Detroit denies it's stalling on Proco or other ideas to clean up the combustion engine. "Give us time and we'll save the old knave," the auto companies declare. They are obviously convinced the old renegade can be saved, as evidenced by the millions of dollars being poured into research—something like \$400 million last year, alone.

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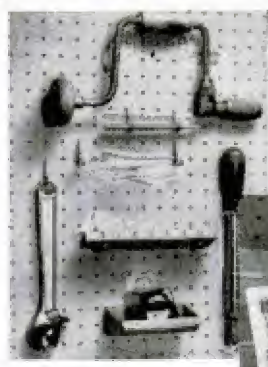
(Continued from page 147)

valve, found beneath the exhaust manifold, is operating freely by seeing that the counterweight moves easily by hand with the engine cold. If the valve is stuck, try to free it with manifold heat control valve lubricant.

If none of the solutions mentioned so far helps to stop a dieseling problem, it is possible (but not likely) that the cause is internal. So-called surface ignition occurs when fuel in the cylinders is ignited by a glowing deposit, such as carbon. It is often accompanied by a knock.

However, don't run to have the engine torn down before you make absolutely sure that after-run isn't being caused by some less serious problem or that it can't be stopped by one of the operational tips noted above.

Dieseling is seldom caused by deposits in the combustion chambers. For one thing, these seldom get hot enough to ignite the fuel mixture. For another, it is most unlikely that a glowing deposit would be present in more than one cylinder. ★★★



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A REAL DRUM TABLE

(Continued from page 166)

if you want to be sure of a good match.

The pivot jig is made with a piece of 1/16-in. mild-steel flat stock of suitable width to fit the accessory slot of your saw. The jig will track the saw properly only if the pivot point is exactly in line with the teeth of the blade.

To accomplish this, fold over the end of the metal into a short right angle so that you can bore the pivot hole offset an amount that is equal to the distance from the front edge of the bar to the teeth of the blade.

I used Conolite "white leather" plastic laminate for the top. This is a flexible laminate that is thinner than high-pressure laminate. It comes in rolls 30 in. wide and can be purchased by the linear foot.

Using tin snips cut the laminate about 1/4 in. oversize. Because this material has a stubborn curl (tendency to reroll), drive a few nails at angles part way into the worktable to hold the piece flat while you apply contact cement. Apply two coats to both the plywood and the laminate, allowing each to dry until it is not tacky.

Once the contact is made, the pieces will be inseparable, so line them up carefully. The use of two sheets of wrapping paper overlapped at the center will aid you in your lineup. Position the laminate centered on the paper-covered wood top. Pull out one of the sheets, allowing the laminate to make partial contact with the wood. Then slide out the remaining sheet of paper.

Trim the overhanging edge of the laminate flush to the wood. If a router is not available, a block plane and file can be used for edge trimming.

Angle brackets hold top

Use a half-dozen metal angle brackets and screws to attach the top to the drum shell. The screws should penetrate through the shell and into one of the bands, as shown in detail at top of page 166. Position the top hoop so it will project about 1/2 in. above the tabletop.

The four drumstick legs are made by inserting 3/8-in. dowels into blocks of wood which are then turned to shape on the lathe (see Fig. 10 and the leg detail on page 166). Use a pair of oval-head, plated screws through each leg to attach them to the hoops. ★★★

ONE (YOUNG) MAN'S SHOP

(Continued from page 99)

ting half blocks, they were used full length—to whatever shape this happened to produce. Wall height was established by a particularly good buy the team got on 1x12 red cedar in 16-foot lengths, which they cut in half for 8-foot vertical wall planking. The rest of the building was "designed to fit" as it went along.

In final form, the structure measures 12 by 17 feet with a roof peak height of about 12 1/2 feet. The roof covering is aluminum to save cost, but Jim splurged on the floor—pouring a concrete slab after deciding that dirt would become muddy when wet and kick up dust when dry.

Jim began moving in his first power tool almost before the concrete had set—an old broken-down table saw his uncle wangled from a friend for nothing. Repaired and painted, it now looks like new. The saw is the shop's work center both in frequency of use and location. Occupying the center of the floor area, it provides plenty of clearance around it for easy handling of long boards and large sheet materials. Anything too big to fit in the shop itself simply sticks out the huge barn doors. Lining the walls are long workbenches, each with a toolboard and parts racks for a particular type of shop work. Along one wall is a wood lathe with its own rack for chisels and accessories. Additional spaces are planned for a bandsaw and jointer.

Young Wilson's shop is so organized and tidy, in fact, that Jim's uncle complains that his nephew's neatness sometimes causes problems. "I'll lay a tool down temporarily while I'm working on a project and when I reach for it a minute or two later, it'll be gone. Jim will have already hung it neatly in its proper place on the toolboard!" Jim and his uncle estimate that the building—including a professionally poured concrete floor—cost about \$800 and tools cost \$400 to \$500.

Among the projects Jim has already built in his newly acquired shop are doghouses, letter holders, benches, tables and chopping blocks—some for sale, but most as gifts for friends and relatives. During summers, he does odd jobs to help earn money to buy more tools. If what he has now at 15 is any indication of what he'll have in a few years, you can watch these pages for another "Great Workshop" that will really be an eye-ful! ★★★



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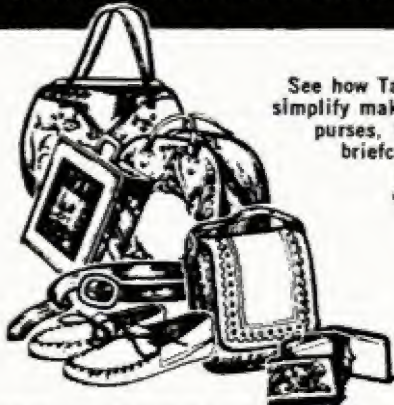
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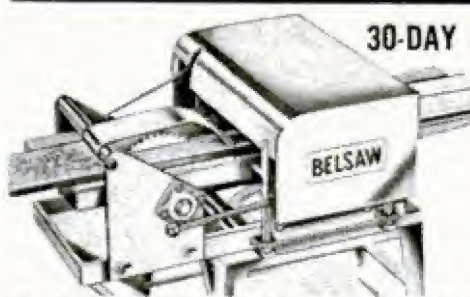


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In my youth I knew the pinch of poverty—the cold stare of the creditor who would not take excuses for money. Today, all that is past, and behind my city house, my summer home, my Cadillacs, my Winter-long vacation—behind this wealth of cash and this deep, inner satisfaction I enjoy—there is one simple secret I would like to impart to you. If you are satisfied with a humdrum life of service to another master, read no further. But, if you are interested in a fuller life—a life free from bosses, fear and worries—then read carefully. My message may be for you.

There is no mysticism in my message. I offer no occult formula that will sweep you to success and riches over night, I am a realist. And I hope you are. And if you are, you have learned there is no reward without effort—that anything worthwhile has to be *earned*. If you have learned this, you may be ready for the next step—to learn and use the secret I have to impart.

I have all the money I need

I have two businesses that pay me an income far beyond my needs. In addition, I have the satisfaction of knowing that I have put more than three hundred other men in businesses of their own.

Please do not misunderstand me. I am not a

philanthropist. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are willing to sacrifice something to achieve success.

Briefly, my secret is a "one man" business that you can operate from your own home in spare time. It is a business that is good winter and summer. Two hours of manual work will keep your "factory" running 24 hours, turning out a product that has a steady and ready demand in your community. Just 98¢ spent for raw materials can bring you \$8.95 in cash—six times a day!

I'll send you the facts... you make the decision

It is impossible for me to tell you the entire story here. And I do not want you to spend a penny now to learn this secret. But I shall be glad to send you all the information *free*. So—if you think there is a destiny that shapes men's lives, send me your name and address right away. I will merely write you a long letter, giving you the complete facts about the business that I have found to be so successful, and you can make your own decision in the privacy of your own home. No salesman will call on you.

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"Lying on the floor in the privacy of my own home, I did one exercise for only 5 minutes a day. I went from 241 pounds to 219, and my waistline went down from 44" to 38".
"Joe Weider's 5 Minute Slimming Plan really gave me a new chance at life. I just can't say enough good things about it."

Michael Benedict

What is this ingenious 5 minute waist shaper plan?

It's based on a patented 1 pound waist slimming exerciser. You lie on your back on the floor, wherever and whenever you wish—even while watching TV. And doing just one enjoyable, rhythmic, continuous movement only 5 minutes a day, you are able to work all your body muscles in one coordinated movement. That's all there is to it.

The Weider Plan is much safer than strenuous gym workouts and is designed to produce a slimmer waistline faster than time-consuming jogging or any other sport.

How much can you expect to lose in 14 days?

You can lose up to 4" off your waistline and about 10 pounds of excess weight in just 14 days. You see, your waist area performs the least work of your body. And because it is usually the most neglected, fat easily accumulates there, giving you a flabby, weak, distorted midsection.

But the rhythmic, continuous movement of the 5 minute Slimmer makes up for all the years you have neglected your body. This concentrated exercise speeds up your body's metabolism, and utilizes your reserve fat to create an oxidation process that burns up excess fat in your body cells. It also helps to release excess water trapped there, too. The results are fantastically rapid waistline losses and a younger looking body for you.

And remember, the Weider 5 Minute Slimming Plan also strengthens your heart, lungs, and helps improve your digestion and stamina. It delivers a lot for just 5 minutes of enjoyable exercise.

Expert testimonials

"The finest, thought out waist-slimming plan ever."

J. SIEGELMAN, M.D., Renowned Swiss Physician

"Because the exercises are carried out while lying on the back, dangerous straining motions are virtually eliminated while the slimming and reshaping of the waistline is taking place."

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"My waist measurement went down 4" in just 10 days, and I feel more energetic than I have in years. It sure beats working out in gyms with heavy equipment."

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Living Proof of Fantastic Results



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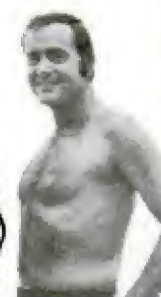
AFTER
WAIST 33"

AFTER
5
DAYS



BEFORE
WAIST 37"

BILL RUSSELL (AGE 38) LOST 10 LBS.



AFTER
WAIST 34½"

AFTER
10
DAYS



BEFORE
WAIST 44"

MICHAEL BENEDICT (AGE 55) LOST 22 LBS.



AFTER
WAIST 38"

AFTER
21
DAYS

5 minute waist slimmer

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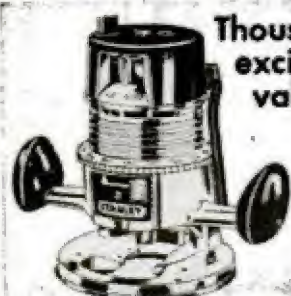
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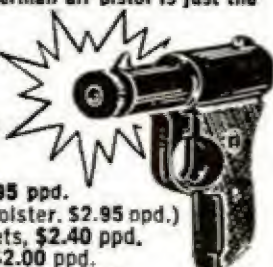
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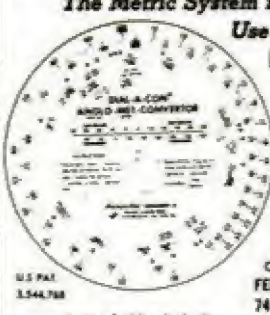
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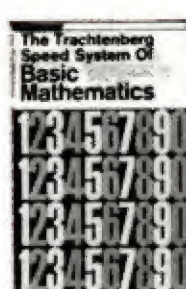
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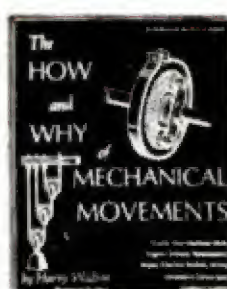
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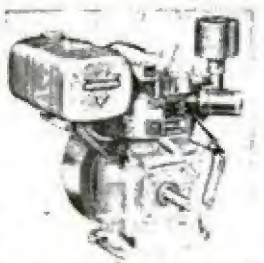
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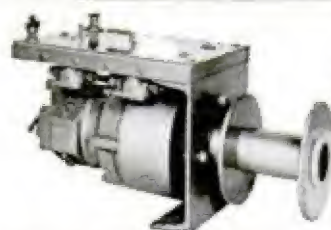
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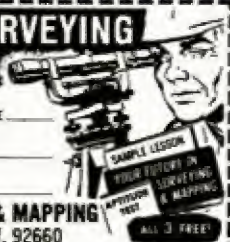
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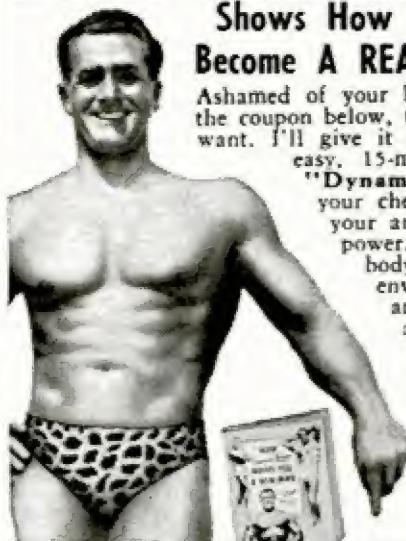
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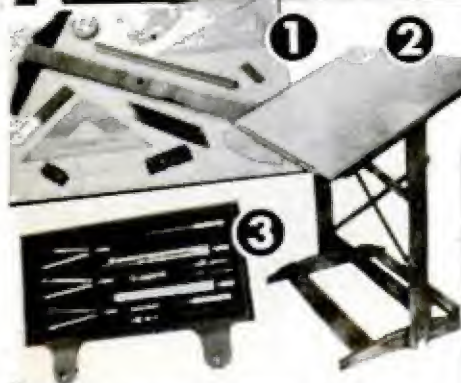
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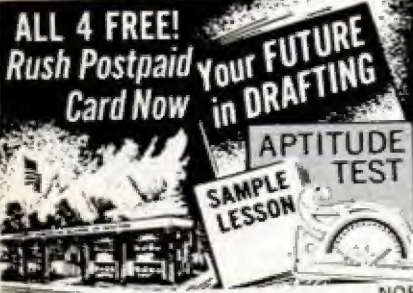
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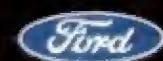
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Front disc brakes and flight bench seat are standard on the 1973 Montego MX Brougham. The vinyl roof, white sidewalls, luxury wheelcovers and bumper rub strip (shown) are optional. Try a test ride at your Lincoln-Mercury dealer. Bring your own camera.

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